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AMERICAN MACHINIST

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Third-class Torpedo Boats for the U. S. S.S. "Maine" and "Texas."

These little vessels are something of a departure in our navy, although they have been in use in other navies for some time. Hitherto our service has devoted its attention to larger torpedo boats like the "Cushing" and the "Ericsson," which are building at the Iowa Iron Works, Dubuque, Iowa.

The functions of the two classes of boats are different, the larger or first-class boats being expected to be capable of keeping the sea for some time, while the small ones are not intended to perform extended service, but simply operate from the ship which carries them. However, they have a high rate of speed and in an action where the vessels to which they belong cannot make as much speed as they can, they could do a great deal of damage.

The boats for the "Maine" and "Texas" are of the same general type, but differ in size, as will be seen by the following table of dimensions:

	"Maine."	"Texas."
Length on L. W. L.	58′ 6″	48′ 1½″
Length over all	61′ 8″	50′
Beam at water line	9′ 3/16″	9′ 3/16″
Mean draught	2′ 2″	2′ 1″½
Displacement, tons	14.8	12.15
Coeff. of fineness	.455	.462
Weight of hull and fittings, lbs.	13,785	10,992
Weight of equipment, lbs.	219	184
Weight of ordnance and armor, lbs.	3,435	3,460

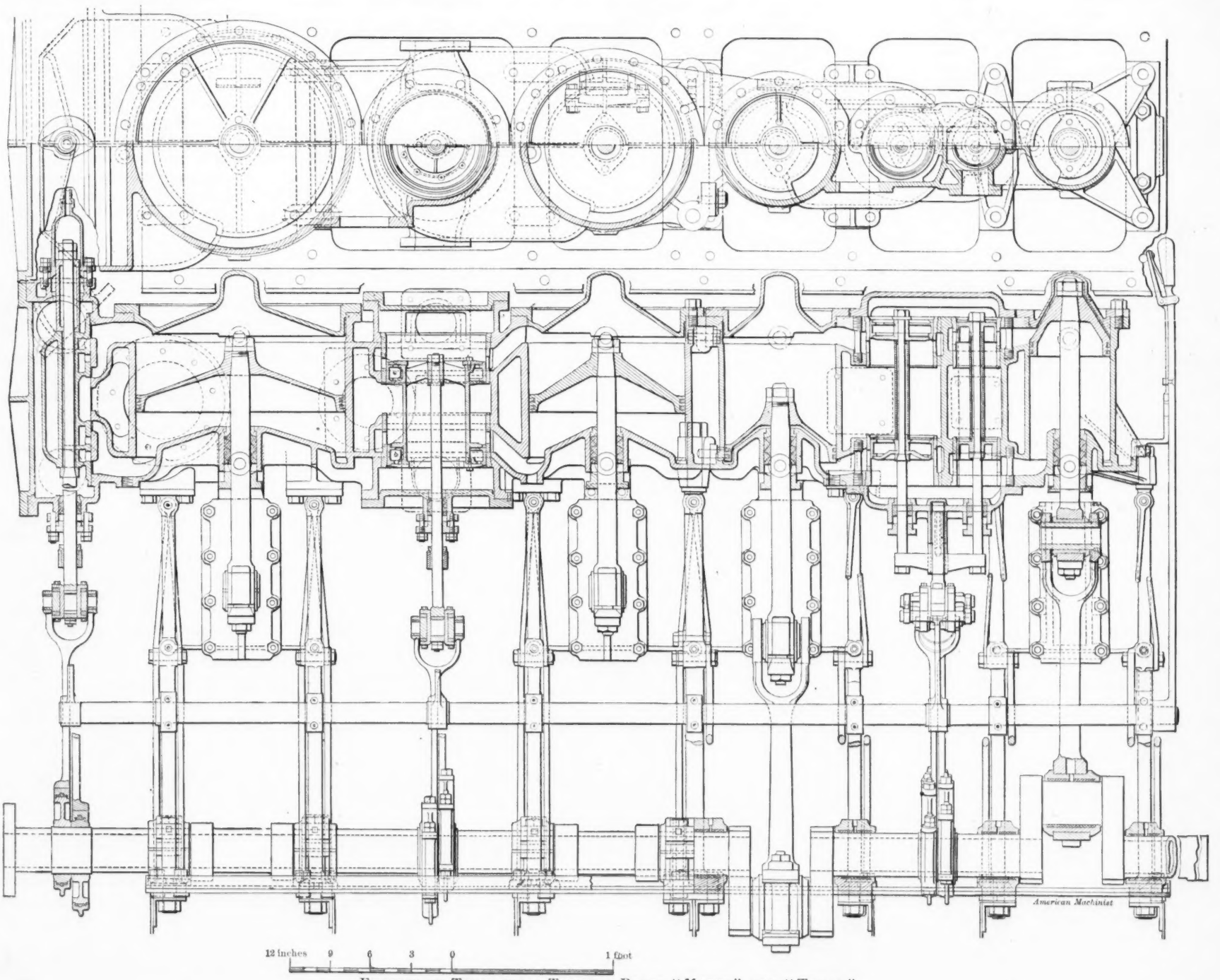
The frames are 1″x1″ by .8 pound, and the reverse frames ⅞″x⅞″ by .7 pound. They will carry a one pdr. R. F. G., and the "Maine's" boats will have a bow torpedo tube for an 18″ Whitehead, while those of the "Texas" will have a deck training tube for a Whitehead of the same size.

The machinery presents a few novel features, although it is chiefly notable for excellence of design to secure lightness and perfect balance of the moving parts. It might be thought at first sight that nothing could be easier than to balance the moving parts by simply making them of equal weight and moving in opposite directions, as has been done in this case, but there is another point which must not be lost sight of, that is the effect of inertia on the power actually given out by the cylinders. This, however, has been carefully considered in these torpedo boats, and there is no doubt that they will work with unusual steadiness and smoothness at the remarkably high speed for which they have been designed. We may explain that the balance has been secured by putting the cranks of the H. P. and 1st. I. P. opposite, and likewise those of the 2d. I. P. and the L. P., while the latter two are at right angles to the first two. As the H. P. piston is necessarily smaller than that of the I. P., and likewise the 2d. I. P. than the L. P., the balance of weight has been secured by making the smaller piston of each pair thicker than absolutely necessary for strength. As usual in all modern naval vessels, the piston rods, connecting rods, etc., are of the same size so that all fittings and spare parts may be interchangeable.

The following table shows the principal dimensions of the machinery:

		"Maine."	"Texas."
Type of engine		Quadruple expansion.	
Diameters of cylinders in inches	H. P.	6.00	5.25
	1st. I. P.	8.37	7.25
	2d. I. P.	11.75	10.00
	L. P.	15.75	14.00
Stroke in inches		8.00	8.00
Condensing surface, square feet		150	116
Revolutions per minute		675	675
Indicated horse-power		200	155
Type of boiler			Tubular.
Steam pressure, lbs.		250	250
Grate surface, square feet		12	9.25
Heating surface, square feet		480	372
Weight of all machinery, including auxiliaries, water and spares, lbs.		12,000	9,500

As already stated, each boat will have a single vertical quadruple expansion engine, working at 250 pounds pressure. The H. P. cylinder will be forward.



ENGINES OF THIRD-CLASS TORPEDO BOATS "MAINE" AND "TEXAS."

The shafting and working parts generally will be of forged open hearth steel; the piston and connecting rods will be oil tempered. The shafting will be hollow. The framing will consist of forged steel columns stayed by diagonal braces so as to give a firm support to the slides and make the whole structure firm and rigid. The engine bed plate is of plate steel supported on keelson plates built in the boat and stiffened by an angle iron running fore and aft on each side of the engine. The engine is also stiffened by the fact that the cylinders have the pairs whose cranks are opposite cast together, while they have the two pairs joined by an interlocking arrangement and secured by turned and driven bolts, making an exceedingly rigid connection.

All of the cylinders except the low pressure will have piston valves, the low pressure having a double ported flat slide; the valves of the H. P. and 1st. I. P. will have no rings while that of the 2d. I. P. will have a broad adjustable ring. The valve gear will be the Stephenson link motion.

A novel feature in these engines will be the air pumps, which are the design of Passed Assistant Engineer Frank H. Bailey, U. S. Navy, chief designer for the Bureau of Steam Engineering.

The pumps are only 3″ in diameter by 3¼″ stroke, and each engine will have two of them driven from an eccentric on the forward end of the shaft. The pumps are horizontal and double acting. The piston is solid, and there are no foot valves, while the delivery valves cover the entire end of the cylinder, being held in place by a light spring. The opening for admission of water and air is at the middle of the length of the cylinder and cuts the cylinder in two, except for the bars across the opening. When the piston is at the end of its stroke, this port is entirely open, but as the piston moves on it gradually closes it, doing so completely somewhat before half stroke.

As is seen at once, the pump is simplicity itself. It is not an experiment in these boats, as one has been tested at various speeds up to 1,000 revolutions per minute with excellent results. To get this last speed, the screw of the launch on which the test was made was removed, and as the condenser was of the keel type, there was naturally very poor circulation of the cooling water, being merely that due to the current in the river. Yet, even under these disadvantageous circumstances, a vacuum was obtained of 20″. This is one of the most remarkable feats in connection with air pumps on record.

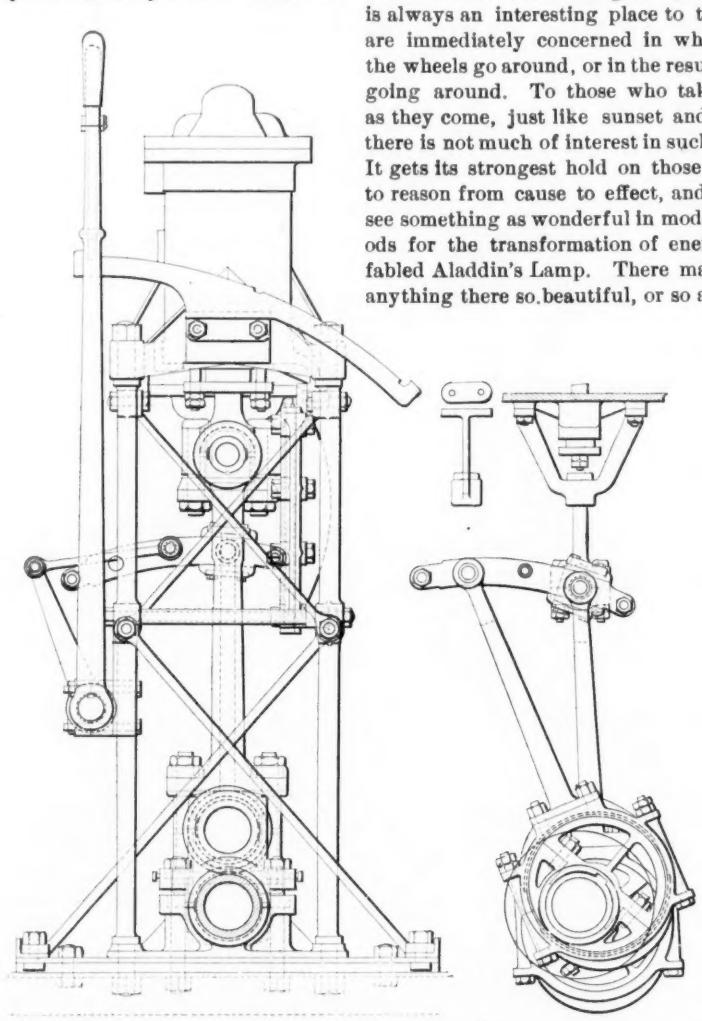
As is seen at once, the use of a pump driven from the main engine and at this high speed saves a great deal of weight.

While the boat is in motion, the cooling water will be circulated through the condenser tubes by means of scoops over the injection and outboard delivery openings, as is the common practice with all torpedo boats, while an auxiliary circulating pump of the centrifugal type is fitted with a capacity sufficient for condensing all the steam the boiler will make when the boat is stopped.

The boiler of each boat will be of the coil or tubular type and it is probable that different makes will be used in the different boats so as to get experience with all those of good makers. The Navy Department is thoroughly in earnest in the matter of the introduction of coil boilers as soon as their durability has been thoroughly established, and the building of these boats gives an excellent opportunity for a comparative test.

The forced draught will be on the closed fire-room system, and it is probable that quite a high air pressure will be used, as the great elasticity and thinness of coil boilers enables them to stand any degree of forcing without injury.

An interesting feature, as shown on the drawing of the engines which we give, is the shafting. It hardly amounts to more than a pipe, as the thickness is only three eighths of an inch. This was done, of course, to secure lightness, and comes about because it was necessary to make the external diameter as much as it is to secure bearing surface for the journals. As this would give a strength considerably in excess of the actual requirements, if solid, it has been possible to make a relatively large hole. In large shafting the internal diameter rarely exceeds 50 per cent. of the external, while in this case it is more than 75 per cent.



ENGINES OF TORPEDO BOATS "MAINE" AND "TEXAS."

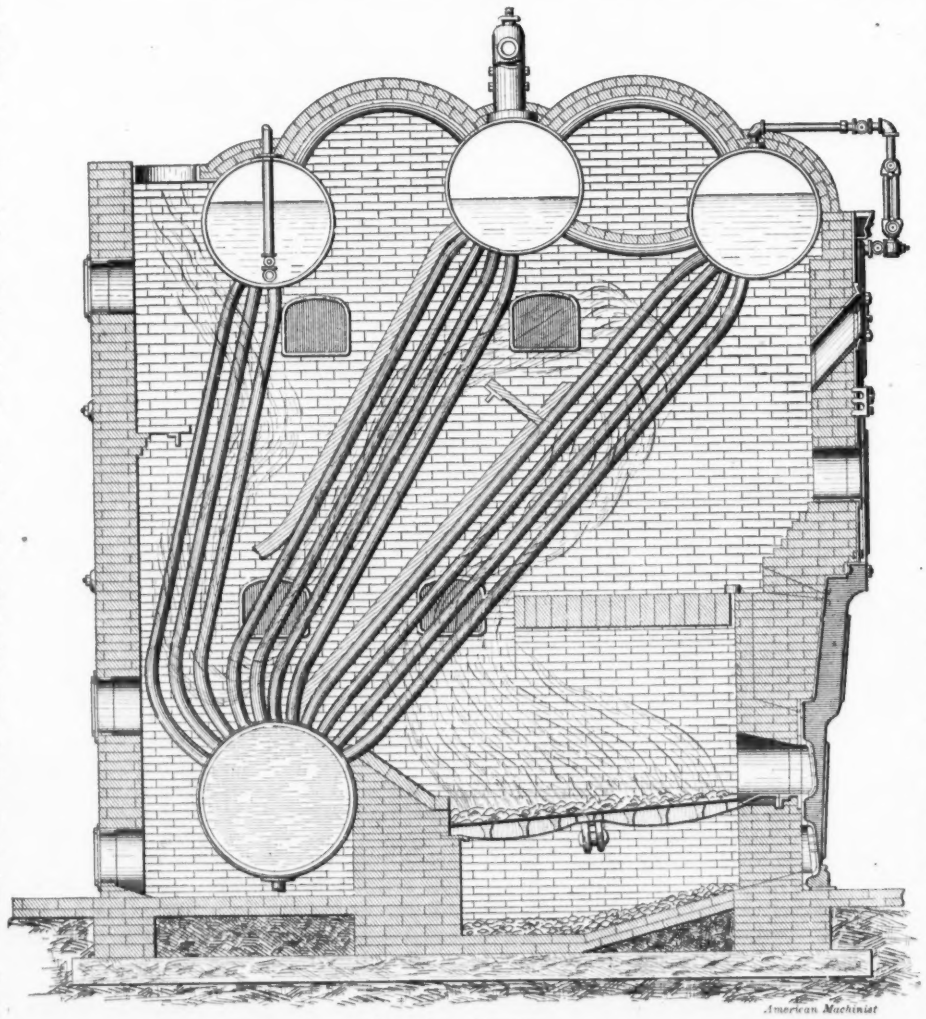
The speed of the "Maine's" boats is expected to be 18 knots, and that of the boats of the "Texas" 17 knots. The hull and machinery of the former are building at the New York Navy Yard, while those of the latter are building at the Norfolk yard.

Notes from the Fair.

Editorial Correspondence.

IN THE BOILER HOUSE.

The boiler house of a great power plant is always an interesting place to those who are immediately concerned in what makes the wheels go around, or in the results of the going around. To those who take things as they come, just like sunset and sunrise, there is not much of interest in such a plant. It gets its strongest hold on those who like to reason from cause to effect, and who can see something as wonderful in modern methods for the transformation of energy, as in fabled Aladdin's Lamp. There may not be anything there so beautiful, or so artistic in form, as a little further up the chain of transformation to the engines, although the day of uncouth, rough looking boiler fronts and boiler fittings is well-nigh of the past, but the boiler house is where the power comes from.



STIRLING BOILER.

In the boiler house here is 25,000 horse-power of boilers, which furnish steam for the engines that do the useful work of driving the machinery and electric lighting, pumps, etc. It is a big boiler house, and a very complete one for the purpose. An engineer who always has some interesting comparison to make rather upset me by suggesting that there was just about the same boiler power here as on the steamship "Campania," with her engines of 30,000 horse-power. The suggestion is full of interest, but a little thought leads to a view somewhat different from that engendered by the first impression. With the forced draught and great economy of the engines of the "Campania," much less heating surface and much less steam is required per horse-power than according to the arbitrary rating here, and elsewhere. In the case of the steamship the boilers are rated by their ability to furnish steam with the engines doing so many horse-power of work; here by their ability to furnish a given quantity of steam, far in excess of that required by the steamship. This, with the forced draught of the steamship, would put the matter in a quite different light, all of which shows how unsatisfactory it is to *think* of horse-power in connection with a boiler.

If one doubts that the water tube boiler is very much in evidence in this country, he will find presumptive evidence to the contrary of his doubts in the fact that all the boilers here, rated at 20,000 horse-power in the aggregate, but probably capable of being worked at 25,000 to 30,000 horse-power, according to the A. S. M. E. standard, are of that type. It does not, of course, follow from this that a great many boilers other than water tube are not made and sold in this country—nor even that a great many more of other kinds than water tube are not used. I do not know the percentage, but believe it is yet largely in favor of other types, but at any rate they are all water tube here, and it seems to be a fact that as higher steam pressure becomes more common, water tube boilers are more and more called upon to meet it. In some form this type of boiler is old, and it worked its way slowly so long as the limit of pressure was about 70 pounds, but 70 pounds will not do for the modern compound steam engine, and as near absolute safety as is possible is demanded. The steam pressure carried here is 120 pounds, but this pressure could be far exceeded without introducing the element of danger.

There is great similarity in most water tube boilers in common use, as the National, the Abendroth & Root, the Heine, the Zell, the Gill, and the Babcock & Wilcox, all of which are at work here, there being, however, differences enough to get the benefits of our liberal patent laws, and to afford more or less grounds for claims of superiority. The Stirling boiler by the Stirling Company, of Barberton, Ill., of which there are something like 3,000 horse-power, differs from those named, in that the tubes are nearly vertical instead of slightly inclined from the horizontal. The tubes connect a lower shell, or mud drum as it is called, with two or more upper drums, the upper drums being themselves all connected. The sectional view will give an idea of the construction when three upper drums are employed. It is claimed for this boiler that the nearly vertical arrangement of the tubes results in a precipitation of the dirt into the mud drum, from which it can be easily blown out.

The most radical departure, however, is in the Morrin Climax boiler by the Clonbrock Steam Boiler Works, of Brooklyn, N. Y., of which there are three in the boiler house annex. This is a vertical boiler, with U-shaped tubes springing out from and returning to a central vertical shell at different heights, the tubes being expanded in this shell. This boiler was illustrated in our issue of March 28, 1889. Of the three Climax boilers here, one is said to be the largest steam boiler in the world, capable of evaporating 30,000 pounds of water per hour. The inner vertical shell is, I believe, 56 inches diameter and ⅞ inch thick, of steel, with the vertical seam welded

instead of riveted. There are 864 U-shaped tubes, each 3 inches diameter and 12 feet in length before being bent. The total height of this boiler to chimney base is 37 feet, and the floor space occupied is, as may be inferred, small. There are 10,000 square feet of heating surface, and the builders rate the boiler at 1,500 horse power. The two smaller Climax boilers are rated at 750 horse-power each. Near by these boilers is a model of the boiler which not only shows how the hot ascending products of combustion are broken up and brought into contact with the heating surface of the tubes, but as well how any particular one of the perfect network of tubes can be removed and replaced should it become necessary.

Oil is used exclusively for fuel, being piped direct from the oil fields, about 40 miles distant. The oil passes to the furnaces, under slight pressure, through various kinds of burners, the most common form being in shape something like an injector, with an inner and an outer tube, the oil which passes through the annular space between the tubes being atomized and blown into the combustion chamber by steam passing through the inner tubes where it burns with a rather intense heat.

Scientists tell us about the clashing together of the atoms of combustible and of oxygen in their fierce desire for individual destruction in combustion, a desire born of affinity. A more than ordinary illustration of this is seen, or heard, in the combustion chambers of these boilers, the inborn desire of the atoms to meet being aided, I suppose, by the urgent steam jet. Anyhow, the atomic collision results in a noise that is rather confusing at first, in its volume and monotony. Probably custom would work up a condition of rather liking it; of course, it must be borne in mind that in all these boilers a good many burners are uniting their efforts to the common end of noise. It is a relief when a fire-door is opened, which is not very often, it introduces another note into the monotone.

It would not be right, perhaps, to hold out inducements to inventors to waste their time; Edison has just been interviewed into saying again that inventors never get paid for what they do, but if oil is to be the future fuel for steam making, some inventor who will devise an easy way around the noisy part of the burning will be a benefactor if he don't make a cent. Besides affording a relief from the noise, he would probably relieve doctors of the necessity of finding a new name for some disease likely to result from this special torture of the ear.

Oil is a very clean fuel, and gives the fireman plenty of time to watch the water and clean up things that do not get dirty very much. Its use here was almost a necessity. The effect of 25,000 horse-power of boilers dropping unconsumed carbon over Jackson Park from the coal used in this part of the country can be better imagined than it could have been endured. The question of cost did not enter into this case. It has very generally been found that oil for steam making costs considerably more than coal; just how much more is a question that ought to be settled right here as one of the important results of the Fair.

BOILER FEEDERS.

The boilers are fed by both steam pumps and injectors. There is no lack of water from want of capacity for urging it into the boilers far beyond any possible requirements. I noticed in the way of injectors the Penberthy, Watson, Korting, Sellers, Metropolitan, Hancock Inspirator, Friedman, Monitor and Peerless, and in pumps the Davidson (two compounds), Deane, Barr, Knowles, Blake, Marsh, Laidlaw & Dunn, Cameron, Yough, Worthington, Wilson-Snyder, Miller, Valley, Snow, Buffalo, Gould, Hall, McGowan, Blakeslee and Smedley, and as the heat at the time of observation was such as to invite a short stay, perhaps some of both—pumps and injectors—got away. But there isn't any question of there being enough to feed the boilers.

FEED-WATER HEATERS.

In feed-water heaters and purifiers there are the National, Baragwanath, Stillwell-Bierce, Excelsior, Wainwright, Kroeschell & Bourgeois, Webster, Colles, Hoppes, and perhaps some others. Along with the last named, in a glass case to preserve from relic hunters, is a quantity of scale, all right enough in the case, but vastly out of place in the water from which its constituent parts were abstracted by the Hoppes method of purifying feed-water.

As intimated, the boiler house brings a rather vivid sense of heat to one unaccustomed to it; a sense of wasted fuel, energy gone astray. It is not hot, but rather more than warm, notwithstanding it is ventilated by a considerable number of fans in the mouths of large pipes extending upwards from a few feet above the gallery floor to the outside atmosphere. These fans must pump out a large volume of air, without which the place would rival the stoke-hole of an ocean steamship. They are driven, with one exception, by electric motors, the exception being one driven by a rotary engine.

Only a few boiler fronts are painted white, according to orders, and their appearance is marred in comparison with the conventional black of the others. It would rather seem that those in authority—Fair managers—who ordered white painting, labored under the delusion that those who had used and made boilers all their lives had not learned what color to paint the fronts, which is another evidence of the propensity of some minds to meddle with matters beyond their comprehension. Neither are there many attendants dressed in white liveries, bought from the Fair officials at so much a suit.

The boiler plant is one of the most creditable exhibits at the Fair. Nothing approaching it was to be seen at the Paris Exposition. It looks like business all the way through. Those who furnished the boilers did themselves credit. So far as can be seen, all are working finely. The room is neat and clean, and is as comfortable as could be expected where so much that is hot is located in, comparatively, so small space. So far as I know, it is the largest boiler plant in the world, up to date.

STEAM ENGINES.

There is not much to be seen that is new in steam engines, though there are some fine exhibits. There is some evidence of the rather constant intention to make Corliss engines that are not Corliss—not quite—not with a view to getting rid of the hyphen but to make something better. There have in the past been a rather discouraging number of failures in this direction, the failures outnumbering, by far, the successes. Some of the engines here which show study to the end named have been illustrated in these columns; the successes or failures remain to be settled by time. The Corliss engine is a rather simple machine, and not so easily improved as it seems probable it might be. Still there is always room for improvement, or at least opportunity to try for it, and the very engine that shall supplant the Corliss may be here. The Corliss engine has so long been used that there are few prejudices against it to be overcome. To supplant it means the building of a better engine, and in addition the danger of being overwhelmed by prejudice. I am speaking now of engines that are partly Corliss and partly something else, and not of engines of quite different types.

In addition to distinctively American engines with a Corliss leaning, we have shown the large Buckeye engine (there are several Buckeye engines here) with its modified valves, but this engine, which has long since become standard, is something quite different from the Corliss, standing on its merits as a distinct type, it has been used for years in large and small sizes for the usual variety of work for which steam engines are employed. There is, however, a small Buckeye engine shown in which a part of the cylinder and steam chest is cut away, exposing the piston, valves and ports. This exhibit deserves attention, because of its educational feature. It is driven slowly by being belted to, affording an excellent opportunity for observing the valve motion, the large port opening and quick closure at short cut-off. Without asking any questions I assume the object of this exhibit is to show graphically that very excellent steam distribution can be had by the use of properly designed and properly operated riding cut-off valves, and perhaps to answer by the method of direct observation some of the objections occasionally raised against this engine. Whether or not this is the object it accomplishes that purpose very well indeed, accomplishes it better than anything else could do.

In high-speed engines those exhibited are mostly from well-known builders and such as can be seen doing regular work in most parts of the country. There does not appear to have been much recent effort in the direction of higher rotative speed, but there is all the time progress towards smoother running. It is here made rather apparent that balancing and essential points of construction are so well understood by the builders of high-speed engines that something besides difficulty in the way of smooth running must limit speed, if it is to be limited.

In long-stroke, slow-speed engines recent tendency has been towards higher rotative speed, such speed being very well illustrated by a Greene compound engine, with releasing gear, which with a stroke of 42 inches runs at 120 revolutions per minute, giving, as will be seen, high piston speed. Watching this engine run leads to the belief that so far as hooking and unhooking the speed might be considerably increased, but otherwise the engine seems to be running quite fast enough. In increasing the speed much the first trouble might be found elsewhere than with the valve gear, although the speed for that is probably high enough.

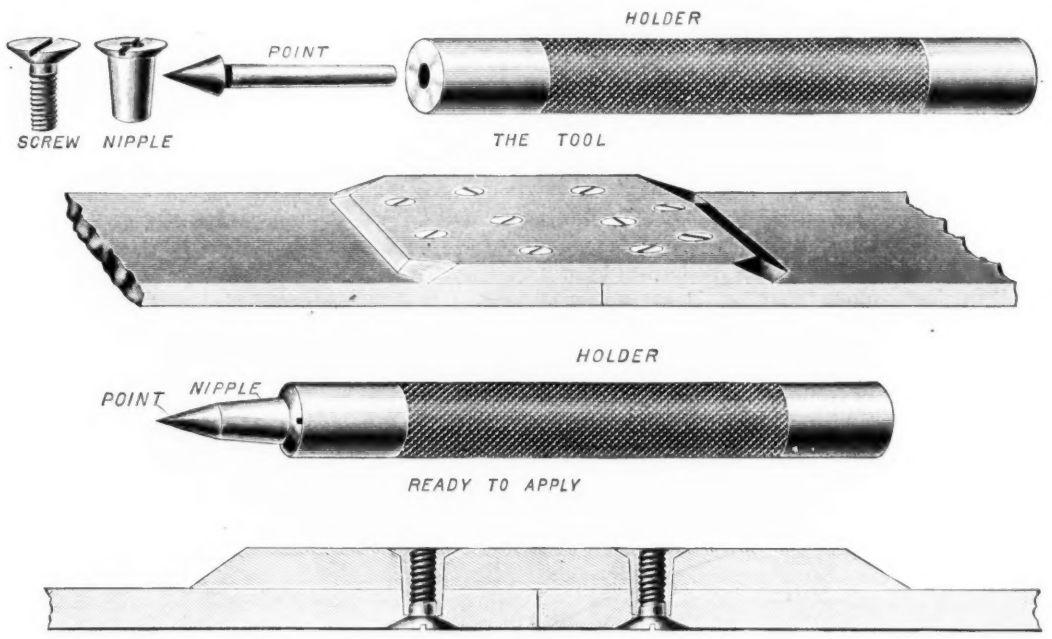
Taking the steam engines as a whole, they do credit to the builders, both European and American. They run quieter than the average at Paris, and in all respects, in most instances, do well in every way. There are not many engines from European builders, which is unfortunate as much might be learned by comparison. Some of the engines that have not been previously noted will be referred to later. H.

In our description of the new drill chuck and reducers, made by the Graham Twist Drill and Chuck Co, of Detroit, Mich., we said that the No. 120 reducer fitted to the No. 1 chuck adapted it for drills from $\frac{3}{32}$" to $\frac{5}{8}$" inclusive. The latter figure should have been $\frac{3}{4}$".

Holroyd & Co., manufacturers of stocks and dies, at Waterford, N. Y., offer to send to any of our readers who will send address a pocket barometer, or weather indicator.

A New Belt Fastener.

We have before referred in these columns to a new belt fastener which is being manufactured by the Billings & Spencer Co., of Hartford, Conn. We herewith present engravings and further particulars regarding it. As will be seen, there is a special punch for inserting the fasteners, this punch being composed of the knurled handle and removable point, behind which the nipple is placed as shown, and then pushed or driven into place without cutting away any of the belt. The handle then comes off the stem and the stem out of the nipple, after which the screw is inserted and tightened up with a screwdriver.



SECTION OF BELT SHOWING FASTENERS IN PLACE

NEW BELT FASTENER.

The engravings show it as applied to a welted joint only, but it is also made shorter to be used in a lapped joint.

This fastener leaves the joint practically as pliable as any other part of the belt; as many of the fasteners can be put in as are needed without limit. The belt can be readily unfastened and joined again without cutting; and the fasteners are not limited to once using, but can be used over and over again; both ends of the fasteners sink below the surface of the belt when tightened, and thus do not come in contact with pulley or catch upon any obstruction. As previously stated, these fasteners are made upon automatic screw machines, in the best manner, of steel.

About Siphons—I.

BY LEICESTER ALLEN.

In the AMERICAN MACHINIST for June 15th Professor Torrey has an interesting letter about siphons, in which he recounts an instance of failure, and after some other instructive remarks he closes his communication with a request for some "siphon history, theory and practice." Professor Torrey is probably not alone in his desire for more information upon this subject. Having been the recipient of many inquiries in my private correspondence requesting advice with reference to siphons, the nature of these inquiries and the sources from which they have come have convinced me that there is quite a general dearth of knowledge upon the true inwardness of siphons among otherwise well-informed and well-instructed mechanics.

Having been obliged to give the subject special attention in my attempts to perfect

an invention in which siphons formed a conspicuous feature, I devoted in 1865–6 a good deal of time in study and experiment with siphons of various forms and sizes, and, later, I spent my spare time for nearly a year in investigating the action of siphons of small size and low heads, and I found in these studies that there were many things about siphons that I could not learn from books. And though my experience has been principally with small siphons I think these studies may be of value as throwing light upon the tricks and manners of siphons, both large and small, which, in use, often prove the most puzzling of perhaps any hydraulic devices.

As to the history of siphons I shall not attempt any important contribution. The most I will do in this line will be to refer to the discussions in a few of the text-books on physics that have held a prominent place in institutions of learning at one time or another. In some of the entanglements which have fallen to my lot in the use of siphons, I have sought in vain for enlightenment from works on physics when resorted to for direct information; though by the application of principles, which, though they affect the action of siphons, are not mentioned in these books in connection with such action, I have generally been able to account for what otherwise would have been wholly inexplicable.

To show how inadequate the treatment of the subject of siphons in text-books has been, I will refer to four different treatises published at intervals during the present century, each, in its time, having been extensively used in colleges and schools. The first of these books is "The Institutes of Natural Philosophy," by William Enfield, LL D., which was printed in London late in the eighteenth century, and republished in Boston in 1802, with an appendix prepared by Samuel Weber, A. M., A. A. S., once a president of Harvard College. In this generally excellent book is the following description of a siphon and explanation of its operation.

Fig. 1 is a reproduction of the figure given in the treatise to illustrate the text.

"Let *D E C* be a bended tube, having one leg longer than the other. This instrument, used for drawing off liquors, is called the siphon. If the shorter leg of the tube be inserted in a vessel of fluid, and if by sucking with the mouth a vacuum be produced in the tube, or if the tube be filled with the fluid before it is used, the fluid will run off from the vessel. The cause of which may be thus explained: The orifice *C*, of the longer leg, is exposed to the pressure of the atmosphere; also since the fluid within the shorter leg is supported by the surrounding fluid in the vessel, the pressure upon the orifice *D* is that of the atmosphere. The two equal orifices are then acted upon by equal pressures; the difference of the lengths of the columns of atmosphere being too small to cause any perceptible difference in their pressure. But these equal pressures are counteracted by the pressures of two unequal columns of fluid *E D*, *E C*. If, therefore, the pressures of the columns of atmosphere be more than sufficient to balance those of the columns of fluid, that which acts with the lesser force, that is, the lesser column *D E* is more pressed against the column *C E*, than the column *C E* is pressed against *D E* at the vertex *E*. Consequently the column *E C* must yield to the greater pressure and flow off through the orifice *C*."

Then the author gives brief directions for the performance of an experiment in drawing off water by a siphon, and for another with a siphon filled with mercury instead of water, and drawing mercury from a vessel from which also air is drawn at the same time, showing that when the air pressure upon the mercury in the vessel ceases the mercury will cease to flow. Lastly, with the statement that "intermitting fountains are natural siphons" all that is said upon the subject in this book is concluded.

The next book to which I will refer is entitled, "An Introduction to Natural Philosophy: Designed as a Text-book for the Use of the Students in Yale College." By Denison Olmsted, A. M., Professor of Mathematics and Natural Philosophy. This book was published in New Haven in 1835. This treatise has the following text upon siphons.

"If a tube having two arms, a longer and a shorter, be filled with water, or any other liquid, and the mouth of the shorter arm be

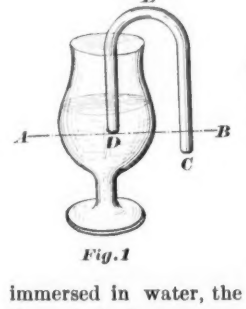


Fig. 1

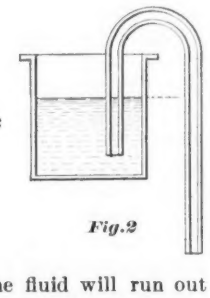


Fig. 2

immersed in water, the fluid will run out through the longer arm until the whole contents of the vessel are discharged. Such a tube is called a siphon. It may be filled with the fluid, either by suction or by pouring water into it, keeping the two orifices closed till the shorter arm is immersed. Or, when the siphon is large, each orifice is plugged and water is poured into an opening in the top of the bend. The opening being closed the shorter leg is placed in the cistern, the plugs removed, and the fluid is discharged through the larger leg. The *principle* of the siphon is as follows: The atmosphere presses equally on the mouths of both arms of the tube; but this pressure on each orifice is diminished by the weight of the column of water in the leg nearest to it; consequently more of the atmospheric pressure is overcome by the longer than by the shorter column, and therefore the effect of pressure (or what remains) is less at the mouth of the longer than at that of the shorter column, and the fluid runs in that direction in which the resistance is least, and the constant pressure of the atmosphere on the surface of the fluid causes the fluid to continue running until the surface has descended to the level of the mouth of the siphon. All this will be obvious by inspection of the figure (Fig. 2).

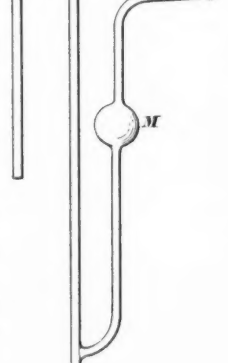
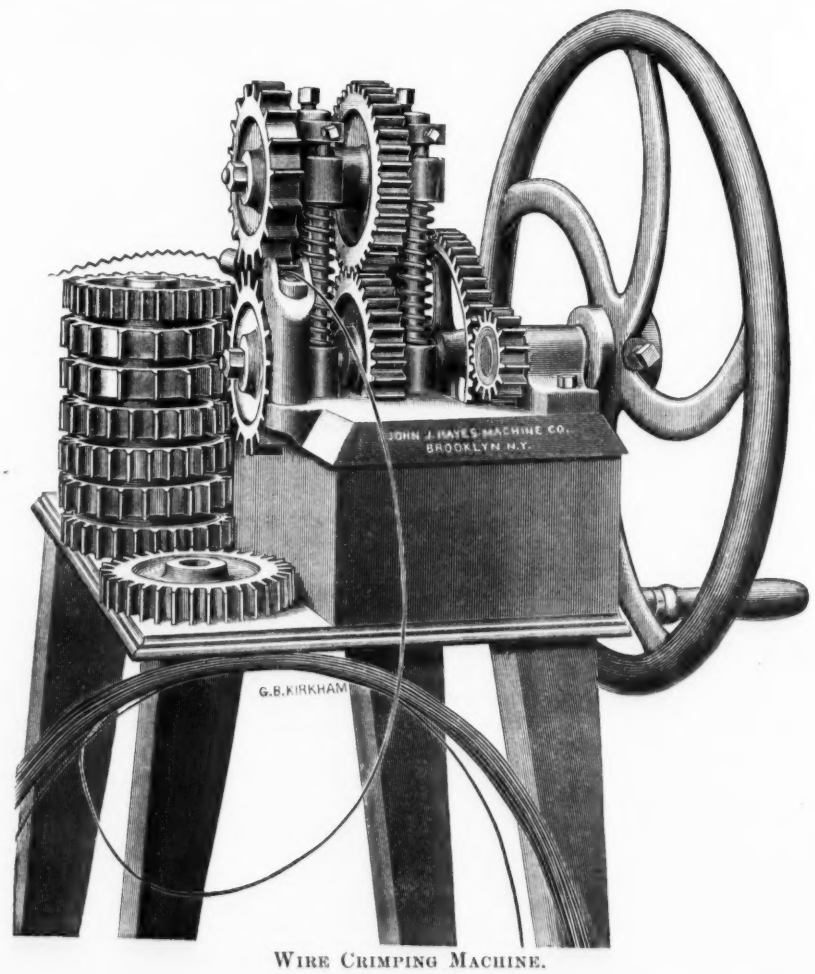


Fig. 3

"Were the shorter column 34 feet in height it would counterbalance the entire pressure of the atmosphere on the surface of the fluid, and consequently there would be no force remaining to drive the water forward through the tube. The siphon, therefore, can never raise water to a greater height than 34 feet nor quicksilver higher than about 30 inches. It is obvious also that the place of delivery, that is, the mouth of the longer arm, must be at a lower level than the surface of the water in the reservoir; so that this instrument cannot be used for elevating, but only for decanting fluids, or transferring them from one vessel to another. Its chief use is by grocers in transferring liquors from one cask to another. It is, however, sometimes employed to convey water from a well situated on rising ground to a lower situation or to carry it over a hill to a lower level on the other side."

Then, after referring intermittent springs to the principle of the siphon, and showing how a spring may be made to intermit its flow by the conformation of the passage through which it finds exit from the earth, the subject is dismissed without further remark.

In 1868 Messrs. Longmans, Green & Company, London, published a translation of Ganot's "Elements De Physique," the translation having been performed by Mr. E. Atkinson, Ph. D., F. C. S., Professor of Experimental Science in the Royal Military College, Sandhurst, England. This work became very soon and also very justly popular as a text book for collegiate institutions in both England and America. It is one of the very best treatises on physics that at that date had ever appeared in the English language. But in treating of siphons it adds absolutely nothing to what was taught in Enfield's and Olmsted's treatises, except a brief description of a form of siphon that had come into use in chemical laboratories which was an improvement upon the simple bent tube, and is shown in Fig. 3. By stopping the end of the longer leg and sucking upon the upper end of the ascending branch *P M O* in the figure such a siphon may be set at work without danger of drawing any of the liquid into the mouth, which makes it a very convenient form when strong acids or other deleterious liquids are to be decanted from one vessel into another. But neither in the general explanation nor in the description of this particular form of siphon is there the slightest hint of any limitation to the action of a siphon due to the nature of the liquid to be siphoned or inherent in some physicial condition that would cause a siphon to work differently at one time than at another, or perhaps make it inoperative temporarily. Neither is any mention made of certain mechanical conditions under which a siphon may be inoperative, while in its construction it accords with all the requirements named in either of the books yet referred to. In a future article it is my purpose to refer to a better treatment of the subject in a treatise which appeared almost contemporaneously with the translation of Ganot's work, but which yet is inadequate in its enunciation of the principles that affect the operation of siphons. For it is true that instead of being as simple as has been thought by many, the operation of a siphon may involve a number of important principles which in its discussion, as found in text-books, are almost wholly ignored.



WIRE CRIMPING MACHINE.

Wire Crimping Machine.

The wire crimping machine of which we give an illustration is designed to crimp wire up to ¼ inch diameter on rollers of the largest pitch, and to $\frac{3}{16}$ inch diameter on all the other rollers. The guides for the wire as it approaches the rolls, and as it passes from them, are arranged so as to secure a straight crimp.

The construction of the machine is exceedingly simple and is so plainly shown that a further description is unnecessary.

The total weight of the machine is 155 pounds. It is built by the John J. Hayes Machine Company, 108 to 118 West street, Greenpoint, Brooklyn, N. Y.

Value of Good will—Use of Machinery.

The Council of Trades and Labor Unions, of Detroit, have issued a pamphlet called the "Columbian Labor Day Souvenir." It contains a number of thoughtful articles, among them one by C. H. Henderson, D. D., on "The Industrial Value of Good-will," a passage of which we quote:

"Marshall, a high authority, says that everything that can be measured in money is a subject of political economy, the science of wealth. But friendliness certainly has a money value as well as other values. Illustration: There is a very reasonable demand in our day for arbitration to displace quarrels. This is well. It is a great advance. But arbitration has its limits. If it means loss to the owners, or starvation to the employes, it is impossible. No method of arbitration can be devised to compel men to carry on a business at a loss of capital or of life. Back of all schemes of arbitration must be the spirit of order, kindliness and 'sweet reasonableness,' which calms men's minds while they consider and sign contracts. A war with England over the Behring Sea seal question would cost us more than all the seals are worth, or ever will be. Any ten ordinary lawyers and expert accountants could give us a wiser and better settlement than two million soldiers, not one of whom ever studied the matter. Why should poor men fight about seal-skins which their wives can never use for cloaks? Leave fighting to cocks, crop-eared dogs and savages, we live in an age of labor, and this is the sacred day of labor. Revenge may be very sweet in the mouth, but it is bitter in the interior. A nervous, excitable woman, finding her sewing machine out of order, got angry and shook and pounded it as if it were a dog, and made it worse. Her neighbor looked the machine over patiently and in good temper, set the thing right, and illustrated the industrial value of self-possession. Horse trainers get more out of vicious horses by kindness than by beating; and calm leaders get more out of employes than do hot tempered and flighty ones. Hard epithets are very natural when we feel we are not getting our just share of the good things of life. But they roil our minds, rob us of pleasure, and put off the day of

victory. For as sure as labor wins its rights, as it must, victory will come as a triumph of human reason, and not of brute force nor of devilish hate."

Writing of "The Mechanical Typesetter," Geo. W. Duncan says:

"Regarding the introduction of machines, the Typographical Union has taken a sensible view of the matter, and recommends that its members learn to run them, so as to be in a position to insist that union men and women be employed as operators. It recognizes the fact that it would be a mistake to try to retard the progress of inventions, which seek to save labor and increase productive power. If the full benefits which ought to accrue to labor from invention are not realized, the remedy must be looked for in some other direction, than in the foolish effort to stand in the way of mechanical improvement."

The Intersection of Cylinders.

By F. R. HONEY.

The construction explained in my last communication to the AMERICAN MACHINIST is applicable in drawing the curve of intersection of two cylinders, provided the axes intersect, and the projection is made on a plane containing, or parallel to, the axes.

First.—To find the curve of intersection when the diameters of the cylinders are unequal.

Let *A*, *B* and *C*, Fig. 1, represent three cylinders or pipes, *A* and *C* intersecting at right angles; *A* and *B* intersecting at any angle. It is required to construct the curves of intersection *a h b* and *c r d*.

To find the curve *a h b:* From *o*, where the axes intersect as a center, with a radius *o e* equal to the radius of the larger cylinder *A*, draw an arc intersecting *f a* produced at *g*. Draw *g h* parallel to *a b*, intersecting *o e* at *h*, the middle point, or vertex of the curve. To find any pair of symmetrical points between *h* and *a* and *b:* From *o* as a center, with a radius less than *o a* and greater than *o e*, draw an arc intersecting *a h* at *p* and *k*, and *i b* produced at *l*. Draw *p n* and *k m* parallel to *f g*. Also draw *l n* parallel to *a b*, intersecting *p n* at *n* and *k m* at *m;* *m* and *n* are points of the required curve *a*, *n*, *h*, *m*, *b*.

With the aid of the explanation afforded by the drawing, the draftsman will have little difficulty in understanding the construction of *c r d*, the curve of intersection of the cylinders *A* and *B*.

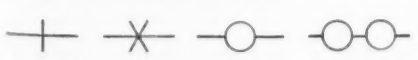
Second.—To find the intersection when the diameters of the cylinders are equal.

Let Fig. 2 represent three cylinders or pipes whose diameters are equal.

The construction of these intersections may be made in precisely the same way as illustrated in Fig. 1, and which is repeated in Fig. 2. But since the points of intersection lie in the same straight line, the drawing is very much simplified. Thus join *o*, where the axes intersect, with *a* and *b* by straight lines; *o a* and *o b* are the intersections of the cylinders *A* and *C*, while $o_1 c$ and $o_1 d$ are the intersections of the cylinders *A* and *B;* *o a* is perpendicular to *o b*, and $o_1 c$ is perpendicular to $o_1 d$. These lines bisect the angles between the elements of the cylinders.

Figs. 3, 4 and 5 represent familiar examples of intersections of cylinders of equal diameters, in each of which the line of intersection *a b* bisects the angle between the elements of the cylinders.

Will the correspondent who favored us with a letter on the subject of marking steel and inclosing impression upon paper of punches used for that purpose as shown below favor us with his address?

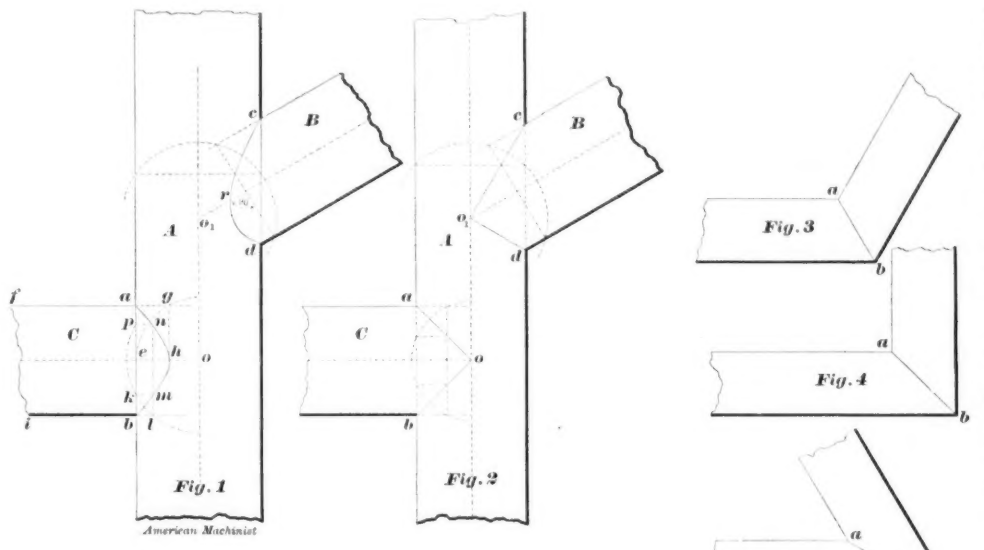


It is estimated that about 95,000 Americans visit Europe every year and spend about $100,000,000 annually abroad.

The Change from Gas to Liquid.

By PROF. F. R. HONEY.

The true import and possibilities of a great discovery or a notable observation rarely appear at first sight. History is full of cases where years have elapsed between the time when a new fact or principle is announced, and the time when it takes its proper place in the progress of science. In fact, in very many cases the discovery has been *quasi* accidental, and the discoverer himself has entirely misconceived its real value. It is one of the things calculated to set any one thinking to see a man actually working against the development of his discovery in the direction which subsequently proves to be the right one. Space will not permit (though I wish it would) any detailed illustration, but I advise any one who wishes to enhance at once the pleasure and efficiency of his work, whatever it be, to study its history.



INTERSECTION OF CYLINDERS.

We have seen (issue of April 27) that Cagniard De La Tour did not at all appreciate the real value of his observations. Indeed, so far as I know, with the single exception of a note in the *Annales de Chimie et de Physique*, Second Series, Vol. XXII, p. 410, in which a few additional experiments are given, he did not pursue the subject farther himself.

In this same connection it is interesting to note that sixteen years before, Northmore had worked on the same problem only from the opposite standpoint. He had started with a substance which, up to that time, had only been known as a gas (chlorine), and, by subjecting it to pressure, had succeeded in reducing it to the liquid state, but here again the great importance and value of the experiment was overlooked by the experimenter, and it remained alone and unfruitful for years.

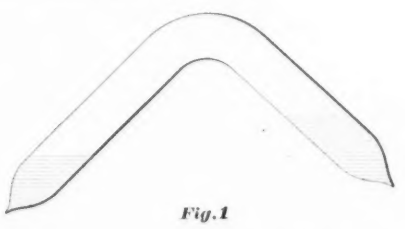


Fig. 1

It is hard for us in these days to see how the indications of these two closely related investigations could have been missed. The first man who did see them and follow them up was Michael Faraday. He saw clearly that if there was, as seemed to be the case, for any liquid, a point of temperature above which it could not longer remain liquid, then those liquids whose critical temperatures were *very low* would be known at ordinary temperatures *only as gases*. If, then, these gases could be exposed by any means to a temperature below their critical temperature, they ought to be easily compressed to liquids. For instance, ordinary air is, it is almost unnecessary to say, known ordinarily as a gas, but only because its critical temperature is very low. In the same way the two gases of which air is composed, oxygen and nitrogen, as well as hydrogen, till the year 1877 were known only as gases. These particular gases were not investigated by Faraday, but several others were. His method was a very simple one. He prepared a glass tube with very thick strong sides, and bent in the form shown in Fig. 1. In one limb was placed some substance capable of yielding the required gas in large quantities on gentle heating. The other was sealed up, and immersed in a mixture capable of cooling the gas below its critical temperature. Then the other limb was heated gently; the gas was liberated, and, of course, was under great pressure, owing to the confined space in which it was liberated. Under the influence of this pressure and the low temperature the gas was liquefied.

In this way Faraday liquefied chlorine, ammonia, carbonic acid gas, and several others. He soon found, however, just as was to be expected, that the critical points of many gases were tremendously low, and consequently he was not able to apply his simple method to many cases.

Shortly afterward, Thilorier made a large apparatus of iron similar in principle to Faraday's small one, in which large quantities of carbonic acid gas could be liquefied. It was a very dangerous proceeding (the apparatus was made of *cast iron*) and in one or two cases terrible explosions took place from the high pressure generated. Subsequently Natterer contrived a much better machine for the same purpose. The gas is pumped under pressure into a cooled chamber, where it is liquefied. By this apparatus liquid carbonic acid could and can be made by the quart if necessary. A sealed glass tube partially filled with it is a very fascinating plaything, after one's nerves get adjusted to handling it. By simply holding it in the hand all the effects described by De La Tour can be seen. The critical temperature of carbonic acid gas is closely 31° C. or 88° F., so that the warmth of the hand is sufficient to raise it to that temperature. When, however, one has seen the boundary line between liquid and gas slowly disappear, and the liquid all converted into gas, the mind is apt to revert to the pressure the tube is sustaining, and I must confess that to this day I cannot perform the above experiment with unshaken nerves. When liquid carbonic acid is allowed or made to evaporate very rapidly, the cold produced is so great as to *solidify* some of it. It looks just like snow, and does not show much tendency to change. It can be carried in closed vessels with considerable ease. When placed on the hand it does not, owing to poor contact, feel very cold, but if a drop of ether be mixed with it first, it *burns* the hand like red hot iron.

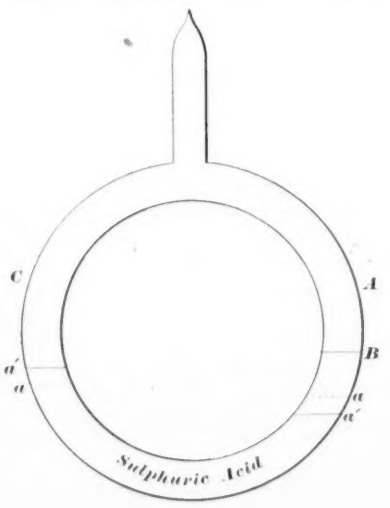


Fig. 2

Another gas liquefied by a similar machine in larger quantities is nitrous oxide or *laughing gas*, as it is called. It is used by dentists, as is well known, and is transported commercially in strong cylinders in the liquid state. After Thilorier come Regnault, Pouillet and Natterer, the latter of whom carried the pressures to which he exposed gases up to the enormous figure of 2,790 atmospheres. Each one of these contributed something to the understanding of the behavior of gases under pressure, but they did not succeed in liquefying oxygen, hydrogen, nitrogen, or air, although they compressed them to very small fractions of their original volumes. Accordingly, in some quarters, the first three of these began to be called *permanent gases*, because there seemed to be little hope of liquefying them.

The researches of Dr. Andrews on critical temperatures are especially worthy of note. They can be found in the Report of the British Association for 1861 (Transactions), p. 76, and in the Philosophical Transactions of the Royal Society, 1869, p. 575. It would be impossible to give any abstract here without taking more space than would be allowable, but the main point reached by him must be stated and emphasized, as it was a beautiful and notable one, namely, that the liquid and gaseous states of matter are not separated by any sharp dividing line, but *shade gradually* into each other. If, for instance, carbonic acid gas be exposed to a high pressure, the temperature being maintained above the critical point, no sign of liquefaction shows itself, and although the gas is greatly compressed, it is still gas. If now the pressure be allowed to fall very gently and slowly till the critical point is reached and passed, one can watch the transition from an undoubtedly gaseous state to an undoubtedly liquid state without being able to select any single point when the change takes place. It has been stated in a previous paper that when a gas is slowly cooled to its critical point there comes a point where crosswise waving lines appear in the gas like those we see in hot air. These appear very gradually, and as the temperature falls lower the line between liquid and gas appears so gradually that it is impossible to tell when it begins. We shall have occasion to return to this point later. It will be of use in assisting us in our discussion of the state of water vapor at or very near its critical temperature. Dr. Andrews also determined with very great care the critical point of carbonic acid gas, which he found to be closely 31° C. (87.9° F.)

It was mentioned a moment ago that attempts to liquefy oxygen, hydrogen, nitrogen, carbon monoxide, and some other gases were for a long time entirely unsuccessful.

On the 22d of December, 1877, the spell was broken. Two Frenchmen, neither of them purely scientific men, both practical men of large engineering experience and skill, working independently of each other, and by totally different methods and machinery, succeeded in liquefying both oxygen and hydrogen. Their results were presented to the French Academy on the 24th of December, 1877. Even at the risk of writing only for the few that may be interested, I must give some little idea of the

methods used by these two able experimenters.

M. Pictet's apparatus was a very elaborate and beautiful piece of work. It was a high feat of engineering. The general principle he worked on was this: Every one knows that by blowing across the surface of water in a dish it is made to evaporate more rapidly. It also grows notably cooler. This is because it takes heat to change matter from a liquid to a gaseous condition. In this case the water evaporates so rapidly that it uses up its own heat for the purpose. Now when liquefied carbonic acid gas is caused to evaporate rapidly the temperature falls to about –130° C.! So that by immersing a tube containing the gas we wish to experiment with in another containing rapidly evaporating liquefied carbonic acid, we can and do expose it to a temperature of about –130° C.

Now Pictet used this principle. His apparatus consisted of two sets of compression pumps. One set was used for liquefying sulphurous oxide (the choking gas which is formed when a sulphur match burns). This liquefied gas was taken into a jacket, which inclosed a tube containing carbonic acid gas, and by causing the liquid sulphurous oxide to evaporate rapidly, the temperature fell so low as to liquefy the carbonic acid gas in the interior tube with the aid of only a slight pressure (about three atmospheres), which was supplied by the compression pumps. *This liquid carbonic acid* was now in turn used for producing by its rapid evaporation the intense cold necessary to carry the oxygen gas down to its critical point. The oxygen was now liberated by proper chemical means under the enormous pressure of 526 atmospheres, and conducted into a strong tube surrounded with a jacket of rapidly evaporating liquid carbonic acid, supplied and kept in circulation by the pumps just as in the ice machines of to-day. By the combination of the pressure and cold the oxygen was liquefied. When a stop-cock attached to the tube containing the oxygen was opened, the liquid issued in a dazzling white jet. Practically the same results were obtained with hydrogen, only the pressure in this case was 650 atmospheres, and the temperature –140° C.! The issuing jet of liquid hydrogen was steel blue, and as it struck the floor sounded like a shower of shot or hard granules. It is believed that some of the hydrogen was actually *solidified*.

M. Cailletet took a slightly different method, and a much simpler one, but not capable of producing such large quantities of the liquid gases. He took advantage of the fact that when a gas is strongly compressed, and then the pressure is suddenly released, great cold is produced by the rapid expansion of the confined gas. Every one who has been near air compressors has noticed that the pipes carrying the compressed air are always quite warm, and the converse is true. If a gas is rarified its temperature falls. Cailletet confined his gases in strong tubes, and subjected them to pressures of 300 atmospheres or thereabouts. After waiting till the heat generated by this compression had disappeared, he opened a valve, and very suddenly released the pressure. The temperature in this case falls to something like –150° C., and at this temperature the gas is liquefied, as is shown by the production in the tube of a *thick mist*. Full descriptions can be found of the work of these experimenters in *Comptes Rendus*, LXXXV, 1214, and *Annales de Chimie et de Physique* [5] XIII, p. 145. Since then considerable work has been done by various experimenters, particularly on liquid hydrogen and oxygen. The latest word is Professor Dewar's recent lecture before the Royal Institution of Great Britain. In this lecture everything was on a heroic scale. Liquid oxygen was exhibited by the pint as a beautiful transparent liquid, with a slight bluish tinge *strongly attracted by the magnet*. When a test tube was placed upright in a vessel containing rapidly evaporating liquid oxygen, the tube gradually filled up with *liquid air*.

But we must leave this field; perhaps too much has been said already. We hasten on to something bearing more on the actual condition of matter near the critical point. Consider now the case of a tube containing a liquid which is just at its critical temperature. The boundary line grows faint and disappears. Has the liquid actually disappeared, or has the *surface only* disappeared? In other words, is it exactly at the moment of disappearance of the *surface* of the liquid that *all liquid disappears?* It seems possible that such may not be the case. It would rather seem that if the liquid and gaseous states shade into each other the liquid ought to disappear *gradually*, and it is rather natural than otherwise that the surface should disappear first. An experiment described recently by Cailletet and Colardeau, in the *Annales de Chimie et de Physique* [6] Vol. 17, p. 269, seems to prove this quite conclusively. A tube was prepared like that shown in Fig. 2, and filled with ordinary sulphuric acid to a level *a a*. Into the remainder of the tube carbonic acid gas was compressed. When the limb *A* was cooled by a freezing mixture, some carbonic acid liquefied and condensed above the sulphuric acid. Of course, this pushed up the sulphuric acid level in the other limb, so that there was quite a difference in level in the two limbs. (Let *a' a'* be the new position of the sulphuric acid level.) Now on heating the limb *A* slowly up to 31°, the critical point of carbonic acid gas, the surface *B* of the liquefied gas disappears. Now if the liquid is all gone, and all the space above the acid is occupied by a mere gas like air, then the sulphuric acid levels ought to come back even again. *But they do not*, as a matter of fact, so whatever you choose to call the substance you have there in the space above the acid, it is certainly not a *homogeneous gas*. It is evidently more dense in the limb *A* than in *C*. So then we come back to our iron ball full of water. Heat it up to its critical point. The water is in a sort of transition stage between liquid and solid. If the temperature is carried up several degrees, the process of change goes steadily on, and finally there must be present there actual homogeneous water vapor. If the experiment could be carried out in any transparent material, like a quartz tube, for instance, we could then be sure, for there are plenty of ways to tell whether we have in a given tube water or water vapor, but as the critical point of water, as stated in the last paper, is probably about 700° C., the probability is that it will not be tried. Water acts on glass notably at ordinary temperatures, and at the boiling point more rapidly. Steam at high pressures attacks and weakens glass in course of time, and at temperatures near low redness corrodes and dissolves it with considerable vigor. The weakening and breaking of gauge glasses is very largely due to this cause. So I am afraid a glass globe or tube would have a hard turn at 700°; and the quartz globe, while it would easily stand the temperature without melting (as the glass would not) would hardly stand the action of steam at that temperature and pressure better than the glass would.

LETTERS FROM PRACTICAL MEN.

Horse-power of Gear Teeth.

Editor American Machinist:

In an article entitled as above in the American Machinist for May 5, 1893, Mr. Wilfred Lewis presented the results of his investigation of the strength of gear teeth. These results are represented by the formula

$$W = s\,p\,f\,y = \frac{33{,}000 \text{ H. P.}}{v}.$$

Where W = working load in pounds;
s = fiber stress varying with the velocity;
p = pitch in inches;
f = face;
v = velocity at pitch line in feet per minute;
y = a factor depending upon the shape of the teeth.

To see how Mr. Lewis derives his values for s and y the reader is referred to the paper above cited.

For most purposes the formula may be more conveniently expressed in the form

$$\text{H. P.} = \frac{s\,p\,f\,y\,v}{33{,}000},$$

and it is from this equation that the accompanying diagram is derived. The values of y expressed in terms of the number of teeth are separately plotted for the three distinct styles usually employed, involute 20°, involute 15° (and cycloid), and radial flank teeth. The two sets of figures for horse-powers in light and dark face type, and for pitch and face are for fine and coarse pitches respectively.

To use the diagram suppose, for example, one has 4½″ pitch, 15″ face, 700 feet velocity per minute, 21 teeth, and a 20° involute tooth is to be used. Pick out 4½″ in the lower left-hand corner of the diagram on the horizontal lines representing pitch, pass to the left until the "face" diagonal 15″ is reached, pass from the intersection vertically to an intersection with the "velocity" diagonal 700 feet, and from that point go horizontally to the right until intersection is made with the diagonal for 21 teeth, "involute 20° obliquity." Following this intersection downwards one reads the horse-power 400. If the face given should be 6″ and the pitch 1¼″, the other conditions remaining the same, these values would be found in small figures and followed out the same as before, the result being 40 horse-power instead of 400 as before.

For horse-power of gears other than of cast iron, cut or machine dressed, multiply the horse power obtained by the diagram by the following factors:

Material.	Factors.		
	Cut.	Rough.	Shrouded.
Steel	2.5	1.25	1.75
Bronze	2.5	1.25	1.75
Brass	1.25	.62	.87
Raw hide	.8	...	...
Cast-iron	...	.5	.7
Cast iron (mortise gearing	.33	....	...

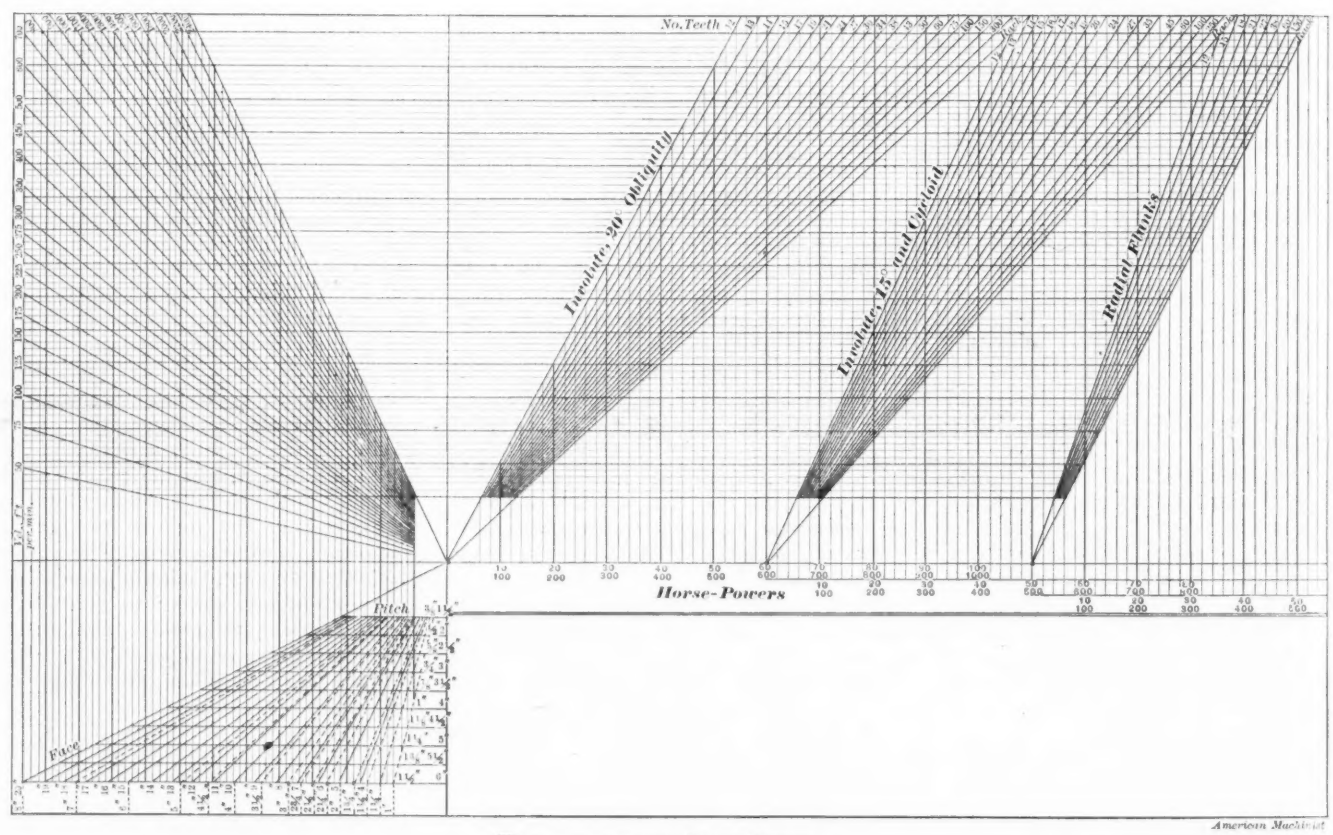
Interpolations between the diagonals may be easily made so that any quantities not given on the diagram may be as readily placed, and the intersections found as though they were given.

The following table of equivalents of circular and diametrical pitches is given for convenience:

Cir. Pitch	3/8″	1/2″	5/8″	3/4″	7/8″	1″
Diam. Pitch	8.378	6.283	5.027	4.189	3.59	3.142
Cir. Pitch	.393″	.449″	.524″	.628″	.785″	.898″
Diam. Pitch	8	7	6	5	4	2½

Cir. Pitch	1 1/8″	1 1/4″	1 3/8″	1 1/2″	1 3/4″	2″
Diam. Pitch	2.793	2.513	2.285	2.094	1.795	1.571
Cir. Pitch	1.047″	1.142″	1.257″	1.396″	1.571″	2.094″
Diam. Pitch	3	2¾	2½	2¼	2	1½

Walter S. Dix.



Horse-power of Gear Teeth.

Sandwich—The Danger of Silt.

Editor American Machinist:

There are some places which seem to have gone out of business. Taking a journey to East Kent on the new river steamer which has been put on to improve the Thames passenger service, I found occasion to go to one of the original Cinque Ports, namely, Sandwich, a town which is remembered as giving a title to that man who invented the dry combination of sawdust which bears the name of the town. This place has gone clean out of business as a port and seems to have found no other occupation. There is what appears to be an old sea bank, but two miles of grass land intervene now between it and the water and a tortuous stream only connects the place with the sea, the mistake in its original choice of a site being that it selected a place removed considerably inland from a line joining two closely adjoining

headlands, and so the silt deposit of the sea has found a quiet place to rest in and killed the port, once so important and still possessing by virtue of ancient charters certain rights and privileges whose present value is as shadowy as the dim past of the town's glory.

One old privilege, not now enjoyed, was the doubtful one of inflicting capital punishment which was by drowning, and there still exists an old document bearing date 1315 preferring a complaint against a certain prior "for that he had diverted the course of a stream named the Gestling, so that the felons could not be executed for want of water."

In viewing the decay and ruin of an old seaport one cannot but think how much of it is due to want of appliances for preventing such decay. Naturally an old river port which would easily accommodate say such ships as Columbus sailed in to America will begin to fall behind as vessels increase in size, and even had Sandwich retained its former depth of water it must still have decayed as ships grew in tonnage.

But had steam dredges been in existence in 1493 when a mole was constructed or had explosives been at hand to destroy the ship which sank at the mouth of the harbor and helped on the process of silting up it is probable that by mechanical means the silt would have been removed and the depth of water kept so that as vessels grew larger there would have been water found for them.

Silting up characterizes old ports still, and, in a figurative sense, old businesses. At Liverpool, as many Americans have found to their delay, the low water depth on the Mersey bar became as little as 9 feet so that many hours were lost if a tide was missed when a steamer arrived.

The Liverpool port authorities had waxed fat and careless, and it required the expenditure by the city of Manchester of eighty million dollars on a ship canal and the further action of the now rival passenger port of Southampton before Liverpool could be brought to the point of using known mechanical appliances to remove the Mersey bar which had become so threatening. Sandwich in a sense is more favorably situated than Liverpool, and might easily dredge a direct channel to deep water, but the time is past for doing this and the work too speculative to undertake in respect of the chance of regaining trade to pay the cost. We have all seen the silting up process in full swing unknown or unperceived by those most vitally interested, and often too when their affairs seemed at the high-water level. It is in fact just such concerns as are at the top of affairs that are apt to become silted up. I have seen an old manufacturing concern that became silted up because an old building stood in its fairway, another became choked with old patterns, and a third was crippled by inefficient steam plant. In every case that occurs to my mind a resolute action taken earlier would have repaid itself. There is a good deal to be said in favor of the American method of constructing things that "will just do" as against our English system of building for eternity before experience has demonstrated that the system will endure so long. If you follow this system the time arrives when you must either sacrifice so-called good stock or else fall hopelessly behind.

The clinging to old stock is the habit of the railroads in the south of England, and the result is deplorable to both the public and shareholders and partly responsible for the success which has attended the supply of fast passenger steamers on the Thames in place of the old tubs.

The preservation of a surplus piece in hopes it will come in is sometimes attended by a brilliant result; the piece does come in and every one is pleased, but, to paraphrase slightly, this one piece of rejoicing is more than counterbalanced by the ninety and nine pieces which will never come to be rejoiced over.

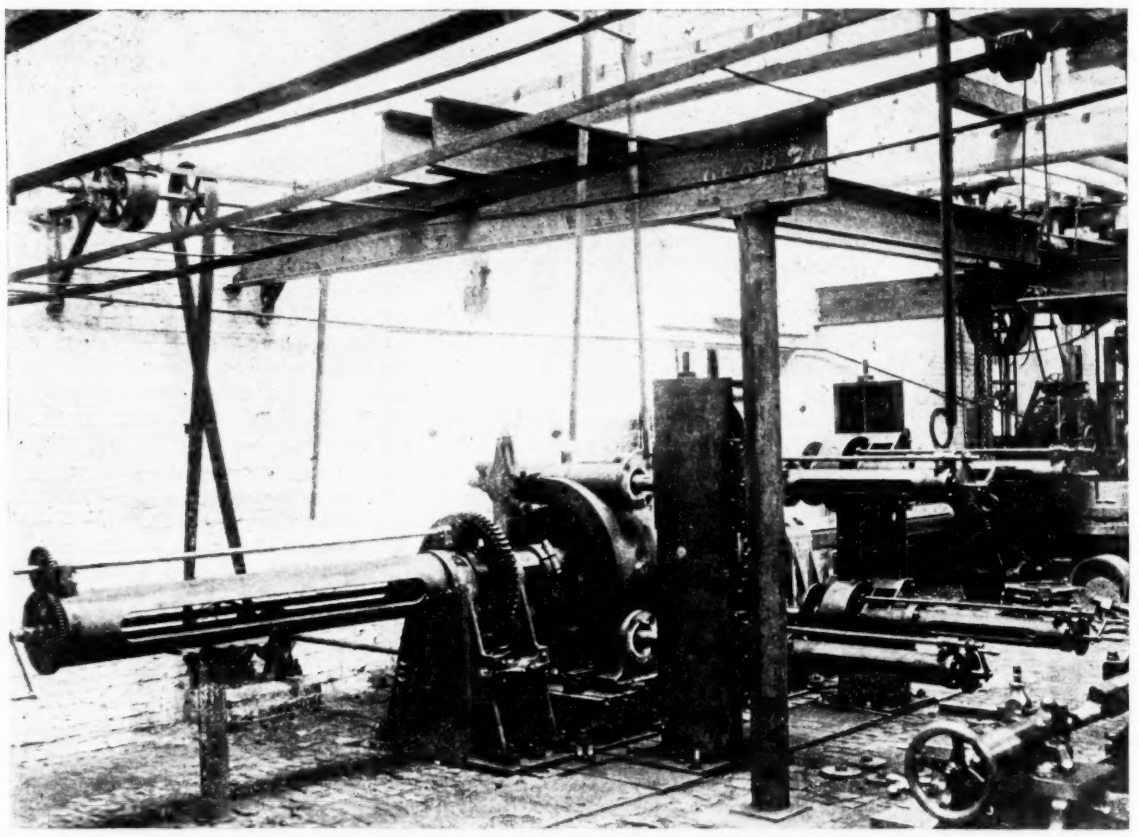
Let a rule be made that things be preserved a week or a month according to the probability of the case or the experience of the business, after which they should be ruthlessly scrapped. The same applies to patterns. When a machine becomes obsolete a period might be allowed for the wearing out of machines, so that customers could obtain duplicate parts, but as orders for such parts thin out it is better to destroy the patterns, as it aids in putting an end to the use of obsolete machinery, and so far is good for the user also. I think places like Sandwich may still serve a useful purpose if we care to learn the lesson.

W. H. BOOTH.

Power of the Injector.

Editor American Machinist:

Mike, the "engineer," made a surprising discovery recently as to the forcing power of the injector. The valve between the injector and boiler was inadvertently closed, and in trying to start the injector, of course, Michael failed, as the injector would do nothing but slobber at the overflow. So he removed the overflow cap and held the valve down with a stick to "make her take." She "took" and burst the feed-pipe, stopping the whole outfit. BENJ. F. WILSON.



BORING CYLINDERS IN A FRENCH MACHINE SHOP.

Boring Cylinders in a French Machine Shop.

We present on this page an engraving made from a photograph of a cylinder and valve seat boring machine, which was constructed and is at work in the shops of the Société Anonyme des Ateliers de Construction, from drawings of H. Bollinckx, the manager, to whose kindness we are indebted for the photograph and the following particulars:

"As you will see, this tool, built in accordance with my own drawings, is boring five holes at a time (cylinder and four valves).

"The largest size of cylinder it will admit is 1 meter and 250 millimeters diameter by 1 meter 800 millimeters stroke (50″x72″). The smallest 400 millimeters diameter by 800 millimeters stroke (16″x32″).

"It is a rapid working tool, since we can finish a cylinder 500 millimeters diameter by 1 meter stroke (20″x40″) in 60 hours, and is also most easy for the men. The four valve holes are perfectly square and parallel to each other and square with the cylinder, and consequently the placing of the cylinder on the tool is most easy and quick. You will also observe that the principle of boring is the same for the 4 bars.

"The bars move forward, and sliding collars or heads are not used; this secures a perfect boring.

"After the first cut is taken by means of cutters fixed in the slots, and this at a cutting speed of 4 to 5 meters per minute, we finish by means of reamers fixed on the bars by means of conical rings, and this at the speed of 3 meters per minute. These reamers are of our system—expansion—so that all our holes are identical, for we can at the slightest wear increase their diameter and regrind at the emery wheel. We use the same system of reamers on our boring machine built by Richards, of Manchester, after the style of Brown & Sharpe.

"At the right of the photo you will also observe the vertical boring and turning machine, after the style of Niles Tool Works, and built by Richards, of Manchester, and with which we are exceedingly well satisfied.

"Cylinder illustrated in the photo has 80.0 millimeters by 1 meter 200 millimeters stroke—equal to 32″x48″."

An Exhibitor's Coat—Awards.

An exhibitor at the Fair is at this writing experiencing the beauties of divided authority, circumlocution, etc., if nothing worse. While talking with a visitor a man entered his enclosure and took his coat, in a pocket of which was his exhibitor's pass. The fellow rather bunglingly and only partially concealed the coat under his own and was arrested at the exit gate and locked up in the regular police station outside the grounds. By means of a card which was in the pocket and which gave location of the exhibit the exhibitor was readily found, and for some days has been dancing attendance at the stations both inside and outside the gates, all the while paying his entrance fee. First they had the coat at the outside station, but the whereabouts of the detective was not known. Then the coat had been sent to the station on the grounds, but upon application there they knew nothing about it. Again, outside the grounds there was no record of such an arrest—he had seen the prisoner in his cell and talked with him—and he must look inside for his property. Just now the exhibitor is speculating as to whether or not he will ever see his property, and also as to what effect a little persuasion in the way of about ten dollars would have had in the beginning. The fellow who was arrested had also in his possession a bottle of champagne, presumably stolen, and the exhibitor suggests that a fairer division would have been to have returned the pass to him, let the thief go with the coat while the police authorities drank the champagne. Anyhow he has found out that there is a good deal of jealousy as between police authority inside and outside Jackson Park, and as between the two not much chance for the man who loses his coat.

The matter of awards is being come at but the action of the powers—or rather the one-man power—has rendered it as certain as anything can well be that the "medal" exhibitors will receive will be a little more useless than is generally the case, which seems to be quite unnecessary. Already the air is full of rumors of efforts at bribery and the like, and no one seems to know much about it anyway. Fortunately, so far as we know, the judges on machinery are good men, but what weight they will have is quite another thing.

An Extension of Gas Consumption.

While electricity is trenching so seriously upon the field of gas lighting, any recent application of gas which leads to an extension of its consumption is of importance to gas producers. Some foreign companies seem to have done this quite successfully in at least one direction. At the recent Dundee meeting of the North British Association of Gas Managers, one member, Mr. J. Ballantyne, of Rothesay, stated that his company had gained an increase of consumption of at least 40 per cent. in about six years, due to cooking by gas among its customers. The gas company furnishes the cookers to its patrons at a rental of 10 per cent. of the list cost price per annum, which charge also includes putting them in, taking them away and keeping them in order. About 11 per cent. of the customers are supplied. His and other companies have not only found this a profitable part of their market, but it has the added advantage of being nearly a daylight consumption, thus tending to equalize the demand on the plant. It is a question worthy of serious consideration whether under proper encouragement this particular application of gaseous fuel could not be much more generally extended.—*Engineering Record.*

One of the difficulties a community has in the effort to help the unemployed to work has been experienced in Chicago. The authorities forced certain contractors to employ men of the city who were out of work. These men were, for the most part, unused to such work, and, of course, could not keep pace with men who had always worked at it. But it appeared that they were so placed that they must do so or drop out, their work being made more than ordinarily hard by the jealousy of the old hands, who worked with increased zeal in order to break down those they considered their rivals. It would seem that if a city was desirous of helping its unemployed—and they must be helped in some way—they could first be given work for a few days under the supervision of the city officials, until they became used to the kind of work, so that they could have some hopes of keeping up their end with those accustomed to it.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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NEW YORK, SEPTEMBER 21, 1893.

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds. As the majority of our friends who visit Chicago during the continuance of the Fair will spend a considerable portion of their time in Machinery Hall, we invite them to make use of our facilities there by having their mail addressed in our care as above, where it will be cared for and delivered on demand either by our own representative or by the person who cares for the space in which our desk is located.

One of the Causes.

There is little doubt but that the present stringency in financial matters has been rendered worse than it otherwise might have been by the premature and unnecessary action of railroad corporations in reducing train service and wages of employes.

As soon as rumors of coming financial difficulties became prevalent, founded mostly on the suspension of a few mismanaged and relatively unimportant banks, some of the companies inaugurated the most radical measures of retrenchment, buying much less supplies than usual, letting off men and cutting wages, thus doing all in their power to make reality of what had before been merely vague rumors of disaster.

It is quite certain that there could be no more effectual way of increasing the dullness throughout a region tributary to a railroad than for that road to discharge a lot of men and reduce the wages of those remaining. We admit the advisability and even necessity of "sailing close" in such times, but in doing so the skillful sailor will usually avoid such tactics as will inevitably increase the forces he has to contend against.

There have been, we are satisfied, many unnecessary reductions in wages also—reductions made for no other reason than that those making them have thought to take advantage of the unusual number of unemployed men to force wages down. This is something that inevitably reacts with tremendous force upon business, and besides in the end usually results in a decreased efficiency of the force taken as a whole to more than overbalance the saving apparently, or, perhaps, temporarily, made by the reduction.

Honor in the Navy.

There are some rather ugly rumors regarding the covering up of deficiencies and inefficiency by naval officers in the supposed interest of other officers. It seems that the officers in charge of the cruiser "Atlanta" allowed the vessel to deteriorate—permitted the doors in the collision bulkheads to become so rusted that they could not be moved at all, while all the while successive reports were being made to the department, according to which reports these and all other things in and about the ship were in the best possible condition, some of the reports stating the time required to close these doors during collision drill, doors which it was subsequently found could not possibly be closed at all. It is supposed that these reports were made and certified to under the impression that it would have been dishonorable for the officer making them to tell the truth and thus necessarily condemn other officers primarily responsible for the condition of things.

It is said that this sort of honor becomes thoroughly drilled into naval cadets at Annapolis, and that nothing is considered quite so dishonorable as for one cadet to reveal any shortcoming of another, even though it be plain that the school and the service are to be injured by the course pursued.

We all know that there is among schoolboys elsewhere than at Annapolis this sort of honor which makes them "stand by" one another in times of difficulty, even to the extent of shielding or even taking punishment in place of the guilty one. This spirit among schoolboys is to be admired, but that it should be carried into the affairs of the navy, where it may easily result not only in the loss of a vessel during a storm or in a collision, but in the death of hundreds who know nothing of such "honorable" proceedings, and would have no sympathy with them if they did, seems almost inconceivable, while at the same time we think of the men taking part in it as sentient human beings.

It would seem to ordinary mortals that the first duty of naval officers was to the government which educates and supports them; that their first thought should be the conscientious performance of duty, regardless of whom might be hit by it, and, finally, that lying is lying whether it is done to shield oneself or another who has failed in his duty and who richly deserves exposure.

It seems probable too that some of the engineer officers of the "Atlanta" have signed their names to reports concerning the condition of the vessel, which, to say the least, they should have known were not true. It is at least certain they did not know them to be true, as they should have done.

Discounts to Members.

One of the latest co-operative schemes has recently been explained by Oliver Sumner Teall, who is the president of a new club to carry it out. In explaining it, Mr. Teall said that a member of the Union and other clubs could procure many things at reduced rates, the clubs making arrangements by which members trading at certain establishments received discounts of varying amounts. The new company proposes simply to make use of this idea. It is called the National Rebate Company. Membership is to cost nothing, and there will be no expense except for clerk hire. A number of merchants have agreed to give discounts to members, their return for this being, of course, in the increased business secured. Though called a "national" company, it is confined to people living in New York—at least for the present.

The Wells Memorial Institute, of Boston, to which many workingmen belong, has for some years had such an arrangement for the benefit of its members, and it is, we believe, found to work well.

If some arrangement could be included in this whereby those who intend to, and actually do pay their bills, did not have also to pay those of persons who have no intention of paying them, it would be a good thing. There are lots of suburban towns about New York in which manufacturing operations are carried on, and which are also places of residence for men who, in some way, make their living by their wits in New York. It is notorious that it is this latter class who run up bills for groceries, dry goods, clothing, etc., and then fail to pay them, the trade of the mechanics and workingmen in these places being considered most desirable because most reliable, and it is an undisputed fact that such men who pay for what they get have to pay an added profit to cover the losses incurred by the trade of the first named class. This is not right, and if some of the co-operative companies can manage to get around this evil, that will in itself enable a considerable discount to be made to people who are in the habit of paying their bills.

It is gratifying to note in all manufacturing quarters a very general tone of hopefulness as to future prospects. Good opportunities for observing this lead us to say without hesitancy that such is the case in all machine business, and it appears to be equally true in all kinds of business. The prospects of a satisfactory solution of the currency question, and the fact that a good many large machinery manufacturers have but little stock on hand are working together to bring about a better feeling, and to set the wheels turning. A little patience is still necessary, but it is never long between daybreak and full light. There is an astonishing amount of energy yet left, and the fact that manufacturers, as a rule, have only looked at the break in the times as temporary, will help to bring good times along. While there are no signs of a boom—the country has seen too much of booms in the past, and it is to be hoped there will be no more—there are signs that improvement will be rapid, and that the country will soon be through the dull spell. If all hope and work to the end of good times, it is about as certain as anything can be that they are near at hand. There are and always will be those who can see nothing satisfactory ahead, but the majority of American manufacturers are not given to neglecting their business in a search after impending disaster that is only in the imagination.

Literary Notes.

THE INFRINGEMENT OF PATENTS for Inventions not Designs—With Sole Reference to the Opinions of the Supreme Court of the United States. By Thomas B. Hall, Esq., of the Cleveland bar. Robert Clarke & Co., publishers, Cincinnati.

This is a book the purpose of which is to set forth the doctrine of the U. S. Supreme Court with reference to the infringement of patents. The subject is divided and treated under four different subjects, viz.: License under the Patent; Identity of the Invention; Validity of the Patent; Recovery for Infringement.

The various phases of these subjects are considered under different heads, the substance of the Supreme Court's decisions being given in as few and as plain words as possible, reference being made to each case so that the full text can be consulted when desired. The whole forms a very convenient and reliable means of ascertaining what has been established as law regarding patents.

The preface to this book is a model and is as follows in full: "The doctrine of the Supreme Court of the United States, touching the subjects herein considered, is presented without personal discussion."

The book contains 275 6"x9" pages bound in law calf, and its price is $5.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(460) J. B. L., Cedar Keys, Fla., writes: Kindly inform me who makes crucibles for melting brass and other metals? *A.*—Jos. Dixon Crucible Company, Jersey City, N. J.

(461) C. A., Houtzdale, Pa., asks: What should be the diameter of the water cylinder of a pump to deliver 1,500 U. S. gallons per minute; stroke 3 feet, and making 50 strokes per minute? What should be the diameter of the steam cylinder, when this pump is placed at a depth of 165 feet from the point of delivery; the effective steam pressure being 45 pounds per square inch? Allow 20 per cent. for loss. *A.*—Diameter of water cylinder 17½ inches; diameter of steam cylinder 23¾ inches.

(462) M. S., Brooklyn, N. Y., writes: Please inform me what chance a fireman has on board a U. S. naval vessel to advance himself. Can he obtain higher positions in that line of work? *A.*—He can advance himself to highest grade of firemen, but this is the limit, as the engineers are taken from the Naval Academy at Annapolis. 2. Which fares the best, the fireman on board the naval vessel or a merchant vessel? *A.*—That depends on the officers in charge. 3. In which of these two services will a fireman have to work the hardest? *A.*—The life of a fireman under any conditions is not an easy one; if he is honest and faithful he will have all he can do in any service.

(463) A. S. F., Saxton, Pa., asks: Can a Corliss engine be run with the steam and exhaust valve disconnected at one

end of the cylinder, the exhaust valve being removed entirely, and the admission valve blocked? My object is to run the engine during the time a new stem is being fitted into the exhaust valve. *A.*—Yes, provided the fly-wheel is heavy enough to carry the engine over the dead centers. You may also have to close the exhaust port after the valve has been taken out Of course, the power developed by the engine running with one steam, and one exhaust valve only will be much reduced.

(464) S. J. O., St. Louis, Mo., writes: Please inform me whether the glass tube in a spirit level is straight or not. If it is what draws the air bubble to the center of the glass? *A.*—In an ordinary spirit level the glass tube is slightly bent so as to form an arc, the highest part being placed upward. In some very fine spirit levels the inside of the tube is ground to a larger diameter in the center than at the ends. The air bubble always seeks the highest point, hence when the tubes are in a level position the air bubble will be in the center. For a further description of levels see our issue of July 14, 1888.

(465) H. R. S., Philadelphia, Pa., writes: Please inform me how I can best temper a steel roller $1\frac{1}{4}$ inches diameter, 12 inches long, and prevent it from cracking during the process of hardening. *A.*—The following has been recommended and is said to have given good results. Heat the steel in a well charred fire (charcoal preferred) until it becomes a bright cherry red, then plunge it in cold soft water, until the outside is hardened, which will take from 1 to 3 minutes, then quickly plunge it into whale oil, and let it remain until cold. This completes the hardening. To temper the roller, first clean it with emery paper, then place it on a bright fire without blast, turning it often until the proper color is obtained.

(466) J. N. B., Newark, N. J., writes: Kindly inform me what, in your experience, has proven to be the best formula for a dipping solution for cleaning and brightening brass castings. *A.*—We suppose you want a solution for cleaning new brass castings as they come from the foundry. Make a solution of two parts of water, two of sulphuric acid, and one of nitric acid. Mix these as follows: First mix the water and sulphuric acid, and let these cool; then add the nitric acid; when this solution is cool it will be ready for use. Dip the castings which are to be cleaned in the solution, and withdraw them quickly; repeat this operation until the castings are bright; rinse in cold water, then in hot water, and finally throw them in sawdust to dry.

(467) V. D., Fredericksburg, Va., writes: Kindly inform me what size of boiler I should use for a 3-inch cylinder engine I want to put it in a boat 20 feet long. Please give all the sizes, as I want to build one. *A.*—The data you have given us is too meager for determining the size of boiler. But on general principles, for the length of boat mentioned, we should use an upright boiler; furnace 19 inches diameter; height of furnace 20 inches; outside diameter of boiler 25 inches; total height of boiler 35 inches; diameter of flue 6 inches. 2. What inspection will the boat have to pass? *A.*—The inspection will be made by an inspector of steam vessels, and it will be such as to determine the safety of its hull, boiler and engine. 3. What license will I require? *A.*—You will require a license as special engineer issued by the supervising inspector of steam vessels.

(468) J. C., Bridgeport, Conn., writes: Please inform me how to build a boat called a bicycle boat. I believe it is made in the State of Maine. As near as I can learn it is built of two boards 20 feet long, 12 inches wide and 1 inch thick, sprung together at the ends, with 30 inches for the breadth of boat at the center; it has no bottom, and is driven by a propeller operated by a pair of pedals and miter gearing. *A.*—You must have been incorrectly informed, a boat of this kind without a bottom would not give sufficient displacement for any practical use. In our opinion the boat to which you refer is nothing more or less than a flat bottomed boat. The pedal mechanism can be of any design by which the power can be transferred from the pedals to the propeller shaft in a convenient and simple way, and will not require ingenuity of a high order to design it. We should, however, not advise you to adopt this mode of applying power, unless you have a special object in view, because with it you will not be able to exert as great a force for propelling the boat as you can with a pair of oars.

(469) A. J. O. N., Waltham, Mass., writes: I have nearly completed a four years' course in the nigh school. My ambition is to be a ship and yacht designer. Would you advise me to enter a ship yard and then an architect's office, or *vice versa?* *A.*—In our opinion it will be best to work in the ship yard first, and after you have obtained a good practical knowledge, then take up office work. In the meantime, do not waste your leisure time, but devote it to study. 2. I have spent some of my time in designing and making models of yachts. My friends say I am wasting time in doing so. Do you think so? *A.*—If you make these models according to scientific principles, a little of this practice will be advantageous, but if you simply cut out the models so as to be pleasing to the eye, your time could be spent to better advantage. 3. Is a knowledge of engines useful? *A.*—Yes; you should make yourself at least conversant with the elementary principles of marine engine construction, but the more you know of this the better. Answers to your other questions would take up too much space, and we must therefore refer you to "Rudiments of Naval Architecture," by James Peake, a good book for you to study; it will give you the information you seek.

(470) W., New York, writes: We have a horizontal fly-wheel weighing about 20,000 pounds. On the upper face of the rim, which is 18 inches wide, there are four rollers 18 inches wide; each one has to support 10,000 pounds. The whole is driven by a pair of bevel wheels on the vertical shaft which supports the fly wheel. What I would like to know is: 1. What horsepower will it take to run the fly-wheel at the rate of 20 revolutions per minute? *A.*—To keep the wheel running at the given speed will require about $7\frac{1}{2}$ horse power. This should be taken as an approximate estimate, as the power will somewhat depend on the diameter of the rollers, and even if this diameter had been given it would be a difficult matter to make accurate computations. 2. What should be the diameter of the thrust bearing at the bottom of shaft? *A.*—To compute this we should know the weight of shaft and gearing. For the weights given, 60,000 pounds, and allowing a pressure of 100 pounds per square inch on thrust bearing, you will need a bearing $27\frac{3}{4}$ inches diameter. A thrust of 100 pounds per square inch is a very liberal one; some authorities do not allow more than 70 pounds, and others take as low as 50 pounds per square inch. 3. What should be the pitch of teeth on the bevel gears? *A.*—That will depend on the diameter of the wheels which you have not given. We would also draw your attention to the rollers, as shown in your sketch, these are shown to be cylindrical. This form will not work under the given conditions; the rollers will have to be conical, and the face of wheel on which these rollers work will have to be turned to suit the conical form of roller.

(471) A. B., ——, Conn., writes: There is a granite column in this vicinity which is being turned up, 41 feet long and 6 feet diameter, weighing about 84 tons. The journals are of cast-iron, 13 inches diameter and 18 inches long; they are made with a flange about 30 inches diameter. These flanges are fastened on to the ends of the column with bolts, which are set in sulphur. Since they have commenced turning the stone the journals at each end have broken off at different times, and they are now waiting for one to be replaced. In my opinion the journals are too small, and they will continue to have trouble until they use larger ones. Kindly give the formula necessary for finding diameter of journal and size of flange. *A.*—The fact that the journals break shows they are not large enough. For computing the diameter of the journal we may consider it to be a cantilever loaded at the end. The load at the end will be 42 tons (one-half of the weight of the column). Under these conditions we have the following formula for finding the diameter of the journal

$$d^3 = \frac{32 \times W \times l}{S \times 3.1416},$$

in which W denotes the weight of half the column, l the length of the journal in inches (18 inches in this case), and S the safe tensile stress per square inch on the outer fibers of the journal. Taking 3 tons for the safe working stress of S and substituting for the symbols in the foregoing formula their values, we have

$$d^3 = \frac{32 \times 42 \times 18}{3 \times 3.1416},$$

which gives us nearly $13\frac{3}{4}$ inches for the diameter of the journal. This allows nothing for the jar in turning, nor for the pressure of the tool against the stone. We should make this journal at least 15 inches in diameter. The foregoing formula has been derived from the fundamental formula given in answer to Question 459 in our issue of September 14, current volume. The flanges are probably bolted to the rough surface of the stone, and consequently the stress due to the bolts, which should be taken into account, will be difficult, if not impossible, to determine. In cases of this kind good judgment is the only guide. We should make the flanges about 32 inches in diameter and 2 inches thick.

(472) W. H. S., Detroit, Mich., writes: Inclosed please find a sketch of two piston rod ends which are tapered, the only difference being that one has a collar against which the piston can be driven, while the other has not. In discussing the matter with my superiors, I have maintained that the collar was necessary, while they claim it is not. Their only reason for using no collar so far, has been that it is easier to make a good fit without the collar. I do not agree with them, and propose making a fit which will allow the collar to come within $\frac{1}{128}$ inch of the piston while cold; then heat the piston and shrink it on. They tell me that the oldest and best engine builders do not use collars. If this is so, perhaps you can tell me why they do it. The taper in this case is 3 inches per 1 foot, which makes the tapered part so short that it leaves a straight bearing through the piston. I hope that I will find this subject satisfactorily explained. *A.*—The reason for making the ends of the piston rods tapered is to obtain a perfect tight fit, and when taper is comparatively slight, there is not much difficulty in making it so. Another reason for making it tapered is that the rod can be withdrawn with greater ease when it is necessary to do so, than when ends are straight; this is probably of greater importance in marine engines than in locomotives or stationary engines. In many marine engines, when the taper extends the whole depth of piston, it is $\frac{3}{4}$ inch per foot, and in locomotives only about half that amount. With slight tapers there is danger of splitting the pistons by the wedging action, and, therefore, the piston rod is turned with a shoulder of $\frac{1}{16}$ to $\frac{1}{8}$ inch deep, the latter being suitable for comparatively large piston rods; this shoulder will also allow the piston rod to be slightly re turned when necessary, without interfering with the taper. Although the necessity of shoulders is advocated by many builders, collars such as you show in your sketch are generally avoided. A taper of 3 inches per foot, and allowing this taper to continue until the section of the rod is three fourths of that of the body, and then turn the remaining part cylindrical is also recommended by many engineers in cases where the ease of withdrawal of the piston rod is of importance, because, even with the liberal taper of $\frac{3}{4}$ inch per foot, there is sometimes considerable trouble experienced in withdrawing the rod after a few months' work. These ends also generally have a shoulder.

(473) Inquirer, Portland, Oregon, writes: Please give me a formula for computing the force of blow from a steam hammer, the weight of the hammer, diameter of the cylinder, and pressure of steam being given. *A.*—The force of the blow can be computed by one of the following formulas: $f\,t = m\,v$ (1) or $f\,s = \frac{1}{2}\,m\,v^2$ (2); in which f is the average force of the blow, t denotes the time of the duration of the blow, s the space through which the hammer head moves in bringing it to rest, m the mass of the falling bodies, and is equal to the total weight of these bodies divided by 32.2 (which is the acceleration due to gravity), and v the velocity in feet per second attained by the falling mass at the beginning of the blow. It will be seen that before either formula can be employed, the velocity v at the beginning of the blow must be known. To make the application of these formulas plain, we will take the following example: Find the force of the blow of a hammer, whose parts, free to fall, such as hammer head, piston, piston rod, etc., weigh 4,000 pounds; the area of the piston is 100 square inches; the effective steam pressure is 60 pounds per square inch; distance through which the falling mass has traveled at the beginning of the blow is 6 feet. Before we can compute the velocity v, we must know the acceleration of the falling mass. The force which causes the acceleration is the force of gravity, which is 4,000 pounds, and the total effective steam pressure which is $100 \times 60 = 6{,}000$ pounds, hence the force which causes acceleration is $4{,}000 + 6{,}000 = 10{,}000$ pounds. The acceleration in feet per second is found by dividing this force by the mass of the falling parts; the mass is equal to $\frac{4{,}000}{32.2} = 124$, fraction neglected, hence the acceleration will be $\frac{10{,}000}{124} = 80.6$ feet per second. The velocity is now found by the following formula: $v = \sqrt{2 \times a \times h}$, in which a denotes the acceleration as found above; and h, the distance through which the falling mass has traveled at the commencement of the blow, 6 feet. Hence $v = \sqrt{2 \times 80.6 \times 6} = 31$ feet per second, in which the small fraction has been neglected. Now we are in a condition to apply formula (1). Let the time t of the duration of the blow, or in other words, the time of bringing the falling mass to rest, be $\frac{1}{93}$ second, then according to the formula we have for the average force of the blow:

$$f = \frac{124 \times 31}{\frac{1}{93}} = 357{,}492 \text{ pounds},$$

or say 178 tons. Now let us employ formula (2); in this the time does not enter into calculation; in place of it we use s, the distance traveled by the falling parts during the blow, or in bringing these parts to rest. To show that the same results can be obtained by formula (2) as before, we take s equal to the distance traveled during the time t. The velocity of the falling parts at the beginning of the blow is 31 feet per second, at the end of the blow the velocity $= 0$, hence the average velocity during the blow is $\frac{31}{2} = 15.5$ feet per second, and the distance traveled during $\frac{1}{93}$ second will be $\frac{15.5 \times 12}{93} = 2$ inches. According to formula (2) we have $f = \frac{1}{2} \times \frac{124 \times 31^2}{\frac{2}{12}} = 357{,}492$ pounds, as before. In these computations friction has been neglected, and the steam pressure has been assumed to be constant throughout the stroke.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

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Gould & Eberhardt, Newark, N. J.

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Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

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Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

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"Pumping Machinery." New book, 450 pp, 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

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"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO. 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Beginning of Economy in Air Compression.

BY FRANK RICHARDS.

If we want to go into the compressed air business "for all there is in it," the way to do it successfully and profitably is first of all to control the whole business. By this I don't mean the establishment of a monopoly whereby we shall have the compression of all the air that is used, although there might be "big money" in that. But with what air we do handle we can't expect to accomplish much unless we have as full control as possible of each of the principal operations involved—the compression, the transmission, and the application or use of the compressed air. There are great losses possible at numerous points, and there are commensurate savings to be effected. The losses can be defeated and the savings accomplished better by a concentrated than by a divided management and accountability.

To begin at the beginning, we first have to do with the "free air," or air at atmospheric pressure. This is our raw material, and it is, of course, desirable to get it as cheaply as possible. Now it so happens that in keeping our accounts in this business, the raw material is measured out to us and charged against us not by weight but by bulk, so that whatever air we want to use it is desirable to get it to the compressor in as small a volume as possible. The smaller the relative volume at the beginning the greater will be its value at the end. The volume of free air varies with the tem-

perature, which means that we want the air as cold as possible. The colder it is the less it will measure in cubic feet, and we may consequently say that the colder it is the cheaper we are getting it.

It seems necessary in all the operations with compressed air to keep the accounts of profit and loss and the record of work accomplished by the volume of *free air* that is handled. This involves fewer uncertainties than if we were to base our computations upon the volume of air after compression to any given pressure. The temperature of the air after the beginning of operations is such an uncertain and variable factor, and is still of such weight in the result, that all calculations are upset by it. The absolute measure of the air operated upon would, of course, be its weight, but this it is not possible to ascertain in extensive practical operations.

The volume of air at common temperatures varies directly as the absolute temperature. The absolute temperature, Fahrenheit, is the recorded temperature + 461°, so that at 60° it will be 60 + 461 = 521°, and the volume will increase or decrease $\frac{1}{521}$ for each degree of rise or fall of temperature. In securing our supply of free air for the compressor, then, if we can get a difference in our favor of 5° by laying a pipe and leading the air in from the outside of the compressor room, or from the shady side of the building, or from the coolest place near by, instead of using the air in the compressor room, we accomplish a saving of about one per cent. If we secure a difference of 10°, which in practice is frequently quite possible, we save two per cent. absolutely without cost, except the cost of the pipe or box to lead the air in. I know that the average machinist or engineer cannot commonly appreciate these small figures or have any respect for such small savings, but when it comes to business I do not know why they should not have the same weight as the same values have in any other of the details of business. Brokers have to live and flourish on commissions of $\frac{1}{4}$ or $\frac{1}{16}$ of one per cent., but mechanics are so wealthy that one or two per cent. is not worth their considering.

The pipe to bring the free air in may as well be of wood or of earthenware as of iron, and, in fact, such material, for its non conductivity, is to be preferred. Some of the compressors of the day can readily be connected with an outside air supply and make provision for it, others cannot easily be so connected, which is unfortunate for them.

Another point that has not hitherto received the attention it deserves, is the necessity, in the interests of the best economy, of not only getting the air as cold as possible *at* the compressor, but of getting it as cold as possible *into* the compressor. We have too easily assumed that the one covers the other, when, as a matter of fact, it never does. The temperature of the air at the cylinder and about to enter it does not guarantee the temperature of the air in the cylinder at the moment when the cylinder is filled and compression begins. It is not too much to say that the temperature of the air outside the cylinder and of that inside is never the same.

He is fortunate who, after saying something that somebody may have taken the trouble to "catch on" to, doesn't find himself under the necessity of supplementing his original speech with explanations of what he *didn't* mean when he said it. Not long ago I was remarking in the AMERICAN MACHINIST that the air compressor is the only perfect field for the use of the indicator, that it is the only place where the indicator cards will tell the whole story, both of the power expended and of the work accomplished. I am afraid I said too much. The air cylinder card doesn't tell all it pretends to tell. You may compute from the card the amount of air apparently compressed, and, later, you may realize that you haven't got the quantity that is represented. This is due to the fact that the card has nothing to say about the actual temperature of the air, either at its admission, at its discharge, or at any point of the stroke. Give me the old steam card yet for downright and outspoken honesty in this respect. I may show you an air cylinder card where the admission line is almost exactly coincident with the atmosphere line, and where the compression line begins to rise above the atmosphere line immediately at the beginning of the compression stroke, showing that the cylinder is completely filled with air at atmospheric pressure, and we will agree to go into ecstacies together over the excellence of the card in this respect. But suppose that when the cylinder is just filled and compression is just beginning, our cylinder is filled with air at 120° instead of at 60°, which is the temperature of the supply. It means that our cylinder holds rather less than .9 of the air that we are assuming it to hold, and which the card says that it holds. It means not merely that the capacity of the compressor is one-tenth less than we assume it to be, but that for the compression of this nine-tenths we are still expending the full power as represented by the steam card. If the difference in indicated horse-power between the air cylinder and the steam cylinder is 10 per cent. of the air cylinder, it is not a bad showing. But if this 1.1, the power of the steam cylinder, is to be compared not with 1, the full capacity of the air cylinder, but with .9, its actual contents, the case is quite different: .9 : 1.1 :: 1 : 1.22, which is a result not worth bragging about by any compressor builder.

There seems to be no means of ascertaining the actual temperature of the air during the operation of compression. The relative temperature at different points of the stroke is evident enough from the indicator card, which shows the pressure attained at that point, but the actual temperature we don't know. Who will tell us how to find it out? Here is a problem that will probably not elicit as many solutions as those which Mr. Leicester Allen has been giving us. It does not seem to be impossible. It looks, at first sight, almost as simple—not quite—as to tell how fast a stream of water flows through a pipe. But nobody yet has invented a satisfactory water meter. In the meantime, we can only use our mechanical judgment and common sense. We can say in a general way that the air should enter the cylinder by the shortest and most direct possible passage, and with as little contact as possible with any metal at a higher temperature than its own.

The American Inventor.

Of all the countries of the world none is so prolific in inventions as America. There are several reasons for this. The ease of obtaining patents, and their cheapness, holds out to every man the chance of creating for himself a piece of property by the exercise of his brains. The high rate of wages insures the inventor of a labor-saving appliance a patient hearing from capitalists, while the independence of thought and feeling, which pervades all classes, leads to original views and to bold attacks on difficult subjects. Hence every one is a potential inventor, especially if he have an acquaintance with science or manufacture. Whatever a man's occupation he must daily find himself called upon to do or to suffer many things from which he would gladly emancipate himself. The proverb says, "There is a remedy for every ill but death," and seeing how many ills there are, the opportunities for devising remedies are not only numberless, but they are present to all.

The Roman millionaire was certainly far better situated than his American representative of to-day. It is true that he could not travel at 60 miles an hour, his yacht could not steam independently of the winds, and his letters took days and weeks to reach their destination, and often miscarried. But his expectations had never soared to such rapid transit, nor to such perfect communication. On the other hand, he enjoyed the unspeakable luxury of perfect service; his slaves were drilled like an artillery regiment, and anticipated his slightest desires; his home was decked with everything that was beautiful, and contained the choice products of the entire world; his food and his wines were not only better prepared than those of common people, but these were different in substance. He had the intense satisfaction of feeling himself apart from the herd of humanity which surrounded him; his superiority was patent to all, and was unquestioned. When he journeyed he did not form a unit in a crowd on an unclassified vehicle, as does the American millionaire of to-day, and when he voyaged a thousand steerage passengers did not share equally with him in the latest outcome of the shipbuilder's art. His chariot and trireme were his own, and were beyond the wildest dreams of hope on the part of those beneath him in station and in fortune.

We need not confine ourselves to Rome for illustrations to show that the rich derived more benefit from their riches in the past than they do to-day. The case of the mediæval baron is one in point. He lacked the delicacy and refinement of surroundings which characterized the Roman, and was, in fact, subject to much we should consider as hardship. But then he was of rough fiber and hardy nature; his ideal of happiness consisted in mastery, and he enjoyed it to the full. In his own district he reigned supreme, not seldom contriving that the king's writ should be of little avail as against his will. His servants were absolutely under his control, and as regards his tenants he pushed his interference, at any rate under some forms of tenure, into the most sacred relations of life. The opinion that he was of a different order to common humanity was not only held by himself, but was received by his social inferiors, and acts that would have roused the deepest resentment if attempted by others were accepted as natural and right from him. Even so late as the commencement of the present century the baron's descendant—the English lord—was paramount in his own district. One could neither live in his village without his good-will nor publish opinions that he disliked. He was surrounded by people who, to all appearance, regarded him as the fountain of knowledge and light. The school children curtsied at the sight of his coach, the laborers doffed their hats before him, while even substantial tenants treated him with extraordinary deference. Every one conspired to give him a good opinion of himself.

It is when we compare the condition of the poor to-day with that of previous ages that we see how much the inventor has done for humanity. To know how hard life must have been before the advent of machinery, we have only to imagine a family set down on an island and called upon to provide all their food and clothing without the aid of modern mechanical appliances—to plough and reap; to thresh, winnow and grind; to raise cattle, kill, and dress them; to shear, card, spin, and weave their wool; to make and mend their clothes; to provide soap, candles, tools, cutlery, earthenware, paper, pencils, nails, medicines, leather, boots, ropes, and the thousand and one things that are needed in a home. Evidently it could not be done, even if labor were continued from dawn to eve and then extended far into the night. And this under the favorable conditions of a yeoman's family, without rent to pay. How much worse must it have been under the exactions of a feudal landlord! Two-thirds of what we consider necessaries must have been omitted from the list of that day, and to sore toil must have been added scanty fare and insufficient clothing.

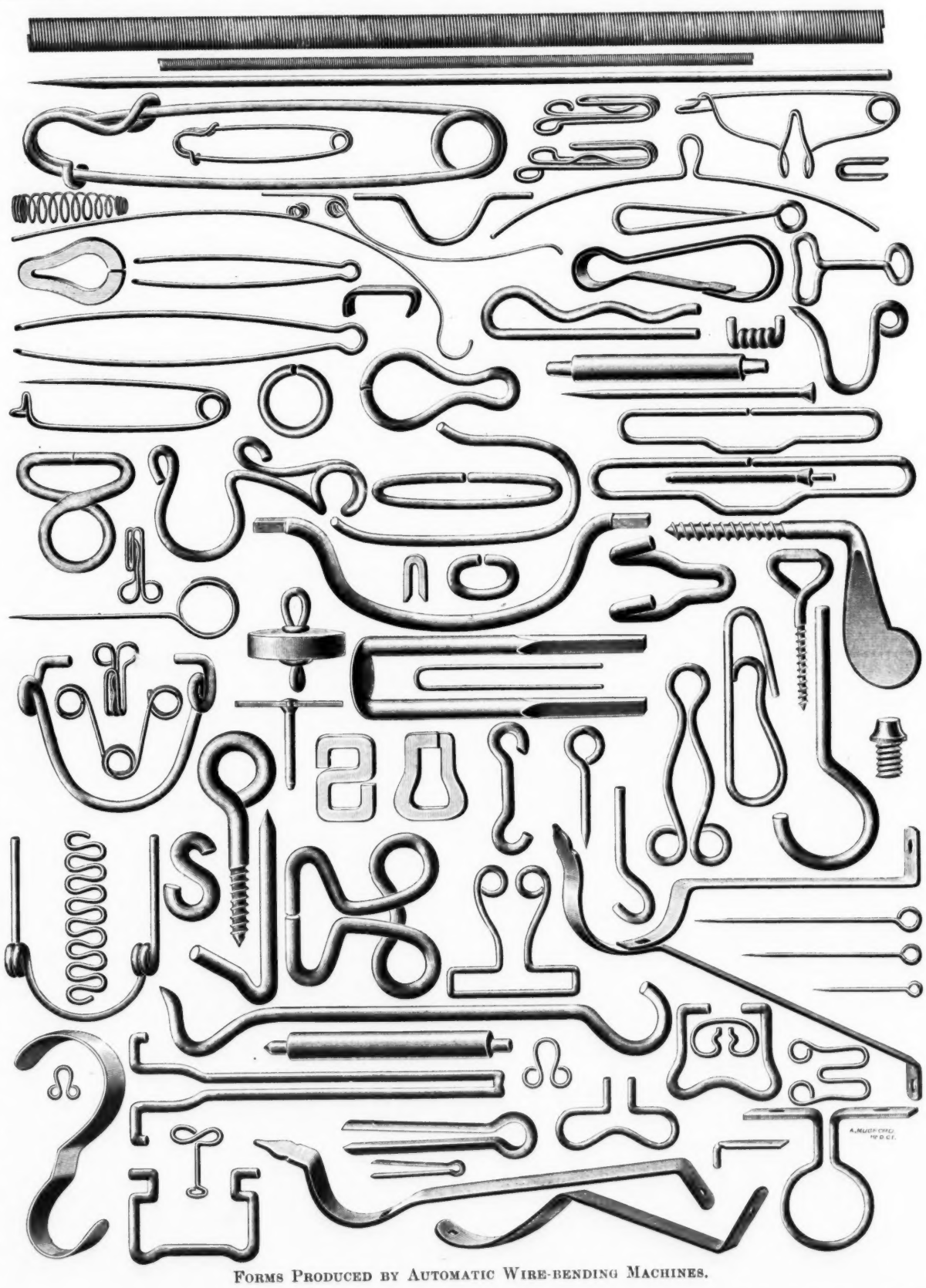
Long before America was discovered the inventor had commenced the amelioration of the lot of the race. The man who devised a form of ship's rigging that would enable a vessel to beat up the wind, unlocked the fetters of thousands of galley slaves, and by rendering communication easier and cheaper made matters better both for buyer and seller. The windmill and the water-wheel released womankind from the immemorial task of "grinding at the wheel" to provide the daily ration of flour. The movable type and printing press did a still greater work by conveying the knowledge of the few to the many, and thus putting the ignorant and the inept in possession of the experience of the wise and the skillful. Besides such notable inventions as these hundreds of a less imposing nature had been made and their authors had passed away and been forgotten. It was only when the patent law was passed in this country that an enduring record was commenced of the names of those who have endeavored to use their brains to save their time and muscles.

The colonization of America commenced, from an Anglo Saxon point of view, with the settlements in the early part of the sixteenth century. By that period an immense progress had been made in arts and manufactures, but still the load of labor pressed very heavily on the lower classes. It was only when the windmill and the water-wheel could be utilized that work could be undertaken on a large scale. The sickle, the scythe, the flail, the hand-loom, the spinning-wheel, the sledge-hammer, the ax, the hand-saw, the file, the wagon—these were the implements with which the clearing and peopling of the forests of the New World were commenced. Much progress was made by their aid, but only as the result of great suffering, indomitable perseverance, and endless labor. In some cases whole settlements perished for want of supplies, cut off from civilization for lack of means of communication; and in others it was only the bounty of nature, in respect of fish and game, that turned the scale. The rigorous climate prevented outdoor work during several months of the year, and manufacturing operations were not sufficiently advanced to enable labor to be fully utilized under shelter. It was the policy of the home government to make the colonists purely agriculturists, and to pay for their foodstuffs and raw products in goods, and for a long time this was successfully pursued. The American inventor had scarcely a market until the connection with England was snapped. Then the aspect of affairs was changed, and the desire to become manufacturing people soon found expression in the passage of a patent law. The first patents were granted in the year 1790, and there were only three of them for that year. The first was to Samuel Hopkins, for a process of manufacturing "pot and pearl ash"; the second was to Joseph Sampson for manufacturing candles, though the method of dipping candles was very generally followed for 60 years after that. The third patent was awarded to Oliver Evans for a method of manufacturing flour and meal. Thirty-three patents were granted in 1791; 9 in 1792; 20 in 1793; 21 in 1794; 11 in 1795; 37 in 1796; 51 in 1797; which appears to have been a year of unwonted activity in the demand for patents, as only one week passed without one being granted. In 1798 the business fell off one half, only 25 patents being awarded, and in 1799 39 were granted. Among the patents for these ten years we find 16 for nail making machines, though nearly all the nails used even during the first years of this century were made by hand, as blacksmiths formerly made horse-shoe nails. During the last decade of the last century only 249 patents were issued by the government. Even as late as Jefferson's administration cabinet meetings were frequently called to consider applications for patents. A thousand patents are now issued for one during the last ten years of the last century.

It is curious to note that, while Mississippi takes one patent for every 20,469 of her population, Connecticut takes one for every 1,018 of hers. South Carolina takes one patent for every 23,490 of her population, and Massachusetts one for every 1,055 of hers. North Carolina takes one for every 21,288, and Rhode Island one for every 1,191. Georgia takes one patent for every 14,817 persons, and New York one for every 1,635. Alabama took one for every 18,457, and Illinois one for every 1,944. Where we find the largest general intelligence, the widest diffusion of the benefit of free schools, there we find the largest

inventive activity, and the best fruitage of mechanical talent.

Many great American inventors have earned world-wide fame: Fitch and Fulton for steamboats, Whitney for the cotton gin, Evans for milling machinery, Whittemore and Jenks for looms, Terry, Ives and Jerome for clocks, Lorillard for tobacco making, Edwards for leather making, Wood for plows, Blanchard for lathes for turning irregular forms, Spencer for geometrical lathes, Hoe, Adams, and Gordon for printing presses, Collins and Root for ax making, Ames for shovels, Woodworth for wood machinery, Fairbanks and Howe for scales, Howe and Crosby for pin making, Knott and Mott for stoves, Stuart for sugar refining, Baldwin and Winans for locomotives, Pullman for sleeping cars, McCormack and Ketchum for reapers, Colt, Sharp, Spencer, Smith, and Wesson for fire-arms, Phillips for matches, Wells for hats, Goodyear for india rubber, Ericsson for naval construction and hot-air engines, Howe, Wilson, Singer, Gibbs, Grover, and Baker for sewing machines, Morse for the telegraph, Tatham for lead pipe, Whipple for screws, Chickering and Steinway for pianos, Burden for horseshoes, Yale for locks, Roebling for wire cables, Corliss for steam engines, Disston for saws, Stephenson for horse cars, and Gatling for quick-firing guns.



FORMS PRODUCED BY AUTOMATIC WIRE-BENDING MACHINES.

The result of all this activity is to be seen in the comfortable condition of the working classes in America. During the term of his patent the inventor, or his assignee, may make money out of it, but when it expires, it practically becomes a gift to the masses. The producing power of the world has been increased manifold without any corresponding increase in the consuming power of the upper classes. The wealthy do not eat more bread and meat to-day than they did years ago. Yet the output of these commodities has been vastly augmented, and they are consumed in large quantities by a section of the population which once seldom got flesh food, and often went short of bread. And so of nearly every other industry; the working classes take the bulk of what is produced, for the very good reason that they are able, by the aid of machinery, to turn out several times as much work in a day as could their forefathers. At the same time that their production has increased their actual labor has diminished. A man with a heavy job in a foot lathe not only worked slowly but painfully. When his long day was ended, every faculty was exhausted, and he tramped home to rest expended both in body and mind. Now he looks on while the lathe does the work, and in the evening discusses the provisions of the Employers' Liability act.—*Engineering.*

Among the passengers on the new steamship "Lucania" was Mr. Thomas G. Clayton, of Derby, Superintendent of Construction of the Midland Railway of England. He comes as the guest of his brother, Mr. James Clayton, President of the Clayton Air Compressor Works, New York, and while here will visit the World's Fair and make a study of the railway systems of this country.

It may interest our readers to know that the record of visitors to the Fair at Chicago is kept and its prompt publication made possible by the use of the Vernon counting register, which we illustrated and described in our issue of December 8, 1892. It is made by the Davids Machine Works, of 129 Worth street, New York. One of the registers is placed over each turnstile, and indicates at all times the number of persons that have passed through it.

Forms Produced by Automatic Wire-bending Machines.

We have from time to time illustrated various automatic machines for bending and forming wire and metallic strips—machines built by Blake & Johnson, Waterbury, Conn.

We present with this an engraving showing some of the forms produced by these machines, all of these being produced by the machine itself from the coil automatically and at a very rapid rate.

E. V. Clemens.

Mr. E. V. Clemens died in New York City, September 3. He was descended on both sides from the earliest settlers in this country. His father, A. B. Clemens, superintendent of the Farrel Foundry and Machine Company, took him as a boy into the shops of that company, in which he began his varied and successful career. His first success was the installation of a sugar plant in Cuba. He was then for a number of years superintendent successively of the National Machinery Company, Tiffin, O.; the Clemens Foundry and Machine Company, Ansonia, Conn.; the Farrel Foundry and Machine Company, Ansonia, Conn.; and for the past five years superintendent of the De La Vergne Refrigerating Machine Company, and later treasurer of the White Cloud Copper Mining Company, both in this city, of which concerns he was one of the leading spirits. He was a member of the Am. Soc. M. E., Am. Soc. C. E., and Engineers' Club, and was also a microscopist of more than ordinary ability. He left a wife and three children.

The Short Electric Railway at Bangkok, Siam.

Mr. Robert M. Boyd, U. S. Vice-Consul-General at Bangkok, Siam, writes under date of June 12, 1893, as follows:

An extensive improvement has just been completed in this city, in which Americans and American inventions have played the leading parts. I refer to the equipment with electricity of the only tramway line here, a tramway which has heretofore been run by horse-power.

In the summer of 1891 the manager of this company made a tour of Europe and the United States, investigating the subject of motive power for street railways. After a thorough investigation of the methods used on both sides of the Atlantic, he entered into a contract with the Short Electric Company, of Cleveland, O., to put in a plant here and equip three miles of road, the cost to be something like $50,000.

In November, 1892, Mr. W. J. Davison, an electrician for the Short Company, arrived in Bangkok, and at once commenced work to carry out the contract, and has just completed his undertaking to the entire satisfaction of the company here—so much so that they are contemplating an extension of the line.

Since the first car was started, some three months ago, the receipts have increased wonderfully. Now, with the entire line completed, enabling the company to run four cars, the increase of receipts has been 30 per cent.

This is the first electric road in the far East, and the satisfactory manner in which this contract has been carried out will not only redound to the credit of the Short Company, but to the electrician—Mr. Davison—whose efforts in their behalf have been crowned with such signal success.

More roads of this character are sure to follow in the East. Very much interest could be aroused here in such things, in my judgment, if the electrical companies at home would send representatives out to the Orient to put their claims before the proper people.—*Electrical Review.*

The following are the principal dimensions of two first-class battleships, "Majestic" and "Magnificent," proposed for the British Navy, and to be built at Portsmouth and Chatham:

Length 390 feet; breadth, extreme, 75 feet; mean draught 27½ feet; displacement 14,900 tons. With a natural draught, a speed of 16½ knots is expected on the eight hours' contractor's trial, and with moderate forced draught the speed is expected to increase to 17¼ to 17½ knots. The armament will include four 12 inch breech loading guns of new type, mounted in pairs, twelve 6 inch quick firing guns, sixteen 12-pounder quick firing guns, and twelve 3-pounders. There will also be five torpedo discharges for 18-inch torpedoes, four of these being submerged.

It is reported that Messrs. George H. McFadden & Bros., of Philadelphia, have in contemplation the establishment of a line of steamers between Galveston, New York and Philadelphia, and perhaps Liverpool. It is expected the line will be in operation inside of the next ninety days.

MANUFACTURES.

The Eagle & Phœnix Co., at Columbus, Ga., are adding new machinery.

The tobacco growers in the vicinity of Sparks, Ga., talk of erecting a factory.

New machinery is to be put in the mills of the Owensboro (Ky.) Woolen-mill Co.

A. M. Ruttler, of Philadelphia, will establish a knitting mill at Escanaba, Mich.

The Gaffney (S. C.) Manufacturing Co. will soon add machinery to their cotton-mill.

At Edgeville, N. H., Roby & Smart's manufactory will make improvements and repairs.

C. A. Carlock has purchased and will operate the Brooker saw-mill plant at Ringgold, Ga.

The Warren Mills (Mass.) burnt some months ago are now in process of rebuilding.

Thomas Develon & Sons, Philadelphia, Pa., have completed an addition to their works.

The Business Men's League may establish the manufacture of cordage at Helena, Ark.

The Annabesacook Mills Co., Monmouth, Me., are erecting a new and larger boiler house.

The Eufaula (Ala.) Cotton-mills Co. have increased their capital from $100,000 to $150,000.

A. G. Morris is erecting a very large and complete foundry and machine shop at Tyrone, Pa.

The Union Pacific Railroad Company has decided to build a 17-stall roundhouse at Starbuck, Wash.

The construction of the proposed water-works system at Greenville, Miss., will be commenced shortly.

The Monumental Chemical Company has commenced the erection of its new plant at South Baltimore, Md.

Ground has been broken for the new N. R. Pegg tool manufactory at Utica, N. Y. The building will be 204x50 feet.

The works of the Pratt & Whitney Co. at Hartford, Conn., are fully employed, running full time and employing 1,100 hands.

The Wrought-iron Bridge Company, of Belair, Md., has secured the contract to build the superstructure of an iron bridge near that place.

At an election held in Mannington, W. Va., on the 28th ult., the borough decided for constructing new water-works. Bonds for $5,000 will be issued.

The Midland Manufacturing Company, of North Topeka, Kan., is making some improvements in its plant, remodeling the buildings and adding a brass foundry.

The New Philadelphia Iron and Steel Company, New Philadelphia, O., will soon commence the erection of a new steel building to be used as an annealing house.

The Campbell Printing Press and Mfg. Co. have recently completed extensive new works in Brooklyn, N. Y., and are removing the mechanical portion of the business from Taunton, Mass. The business office will remain as at present at 160 William street, New York.

The Indianapolis Foundry Company, of Indianapolis, Ind., has its new buildings under roof, and is putting in a stock of raw material preparatory to commencing operations.

The town council of Piedmont, W. Va., has granted the contract to put in the water-works to L. G. Hallock, of Wheeling, for $32,630. The reservoir is to be 70x100 feet and 250 feet high.

The New York Construction and Supply Co., of New York, has been formed, with capital of $20,000, to manufacture machinery. The directors are W. S. Rockwell and E. E. Billow.

The iron foundry of the Walker Pratt Manufacturing Company at Watertown, Mass., has resumed work, after a shutdown of two months. The firm employ 150 hands and all the men will work full time.

The American Sheet-mill at Phillipsburg, N. J., started up on the 11th inst. on full time, all trouble with the puddlers having been adjusted. The mill is well supplied with orders, and will soon begin to work at night.

The new plant to be built at Toledo, O., for the Vulcan Iron Works will comprise a machine shop, 2 stories, 250x105 feet; engine and boiler house, 30x65 feet. The buildings are to be of steel construction, with iron truss roofs.

The General Electric Company has closed a contract with the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., for 200 electric car equipments, comprising the new G. E. 800 motor and the latest type of series parallel controller.

Notice has been given that the large plate-mill of McIlvain & Sons, at Reading, Pa., which has been idle since July, would resume. The firm has received large orders for pipe iron and other orders which will keep the mill in steady operation.

The Otis Steel Company at Cleveland, O., started one furnace on Tuesday in its large smelting house, and on the 13th six of the twelve gangs employed in the forge resume work. It is expected that more men will be put to work before the week is out.

Owing to the great increase in Chicago travel the New York Central Railroad restored to service, beginning September 17, the New York and Chicago limited trains. Existing trains had proven inadequate to accommodate the increased passenger traffic.

The new jewelry factory of W. H. Wilmarth & Co., at Attleboro, Mass., is completed, and work will be started with 150 hands this week. The factory, which is 230x40 feet, three stories, is the largest in the Attleboros, and is capable of accommodating 300 hands.

The Board of Supervisors, of Peoria, Ill., has let a contract to M. Halligan for an iron bridge over a highway for $850. The Wrought-iron Bridge Company, of Canton, O., was awarded the contract for the bridge across the La Marsh Creek in Limestone for $1,440.

The hat factory of W. B. Thom & Co., at Haverhill, Mass., the largest in the Merrimac Valley, announce that they have sufficient orders to warrant them to start up on full time at once. They have been partly shut down several weeks. All the other hat factories are running on full time.

Work has been resumed in the Potter Press Works in Plainfield, N. J. The force was largely cut down some weeks ago, but the orders have come in, and the foundry will resume full time at once, while the machine shops will resume full time as soon as the castings for the big presses are ready.

Work has begun at the new brush factory of Jordan & Christie, just completed at Maplewood, Mass. The firm has had works on Charlestown street, Boston, for some years, and employs about 100 hands. The new factory is 50x133 feet, three stories high, and has a twenty-one horse-power engine for electrical and heating purposes.

At Somersworth, N. H., Tibbetts & Clark's steam mill has resumed work. Fifty looms that were idle in Mill No. 3 have started up. In Mill No 2 316 looms have been shut down for an indefinite period. This is about one-fourth of the total number. The bleachery will start up again soon. Ground has been broken for a new shoe factory.

The D. T. Dudley & Son Company (shuttle manufacturers) at Wilkinsonville, Conn., have their shop wired for electric light, and a dynamo will soon be put in for seventy five lights. Business at these works is very good, as they have orders ahead for six weeks or more. A new trip hammer has been put in and two new drop hammers are to be put in.

Representatives of the H. B. Libby Manufacturing Company, of New York and Chicago, and of the Robinson Manufacturing Company, of Oxford and Portland, Me., have practically decided to begin work at once on a new woolen factory at Welchville, Me. The mill will be a large one, probably twelve set, and equipped with the best modern machinery.

The manager of the potteries of the Trenton (N. J.) pottery syndicate states that he has increased the working force in three of the potteries, and that all the potteries are working now, but not with a full quota of men. The force will be gradually increased each week until the full force is given employment. He reports that orders are beginning to come in for small amounts of goods, and the character of the orders indicate that goods are being sold. Several of the potteries outside of the syndicate have started up with about half the force.

The J. A. Fay and Egan Co., of Cincinnati, conclude a business letter to this office in the following paragraph: "We have to say that matters are picking up a little bit, and, like Brown & Sharpe, we will resume in full in a few days. We hope to have both of our factories running full force and on full time very shortly. We must confess, however, that our foreign trade is a great deal better than that which is domestic. It may be that we pushed a little bit hard for this foreign trade and it has resulted in our getting probably a good share of it. At any rate, matters are improving, and we hope that we are going to have a good fall and a good winter's trade."

A Chicago dispatch of the 14th inst. says: "It took ten locomotives to draw a train into the Polk street station yesterday. The train was the Erie No. 1, bringing passengers from Eastern points, but mainly from New York and Boston. It was made up of twenty drawing-room cars and 100 ordinary coaches and baggage cars. The train was divided into ten sections of twelve cars each. From eighty to ninety persons traveled in each car, or a total of about 10,000 passengers for that one train alone. This is a fair example of the present World's Fair traffic on the Eastern roads. The Western roads are all doing a heavy business but not equal to that now being done by the Eastern lines. The World's Fair travel on the Northwestern is heavier than at any other time. The twenty-two through trains on that road that came in yesterday carried more than 16,000 persons."

Machinists' Supplies and Iron.

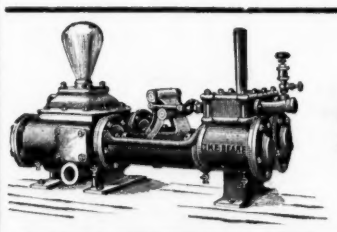
NEW YORK, September 16, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2, and $11.75 to $12.50 for Gray Forge.

Antimony—The market is steady. We quote L. X., 9.90c. to 10c.; Cookson's, 10c. to 10¼c.; Hallett's, 9.65c. to 9.70c., and U. S. French Star, 10¼c.

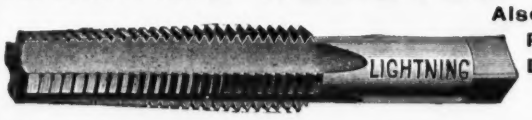
Copper—Holders of Lake Copper are asking 10c., buyers are bidding 9.60c. to 9.75c. Casting Copper is held at 9⅝c. to 9¾c.

Lead—Sellers quote 3.90c. to 4c. for delivery from now to December, but the demand is light and bids are limited to 3.80c. to 3.85c. for carloads.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
PITTSBURG, CHICAGO, NEW YORK.
STEEL FOR Lathe and Planer TOOLS, Cold Chisels, Punches & Dies, Milling Cutters, Molding Bits, &c.
SHEET STEEL, POLISHED Drill Rods, SPRING STEEL, Machinery Steel, COILED SPRINGS, Steel Forgings, ETC.

MACHINE RELIEVED TAPS.—FINEST MADE.


Also DIES, REAMERS, SCREW PLATES, BOLT CUTTERS, DRILLING MACHINES, PUNCHING PRESSES, &c.,
MANUFACTURED BY
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS. Send for New Catalogue

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.

THE MASON LEVER VALVE

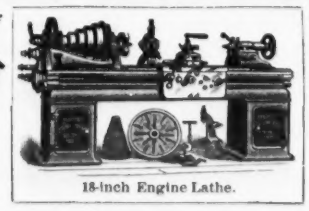
Is made essentially the same as the "Mason Balanced Valve," with the substitution of yoke and lever with weight attached for the bonnet and knuckle joint of the balanced valve. The lever valve will be found useful in controlling the supply of water in tanks by attaching to a ball float. It can also be used to control steam pumps in tank service, by placing the valve in the steam supply pipe to the pump and connecting the lever with a ball float placed in the tank. There is no lost motion in any of the joints, a fact which those desirous of close regulation will appreciate. These valves can be furnished either as piston or seated valves. The latter style is steam tight.
MASON REGULATOR CO.,
BOSTON, MASS., U. S. A.

Books for Molders.
Dingey's Machinery Pattern-Maker.
12mo. Cloth. $2.
BOLLAND, THE IRON FOUNDER.
12mo. Cloth. $2.50.
JOHN WILEY & SONS, - NEW YORK.

GRANT GEARS
Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.

SEBASTIAN LATHE CO.
117 & 119 Culvert St, Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

FITCHBURG MACHINE WORKS,
MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
SEND FOR CATALOGUE E

18-inch Engine Lathe.
THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
FITCHBURG, MASS.

Lard Oil—Prime City is quoted at 65c. to 66c.

Spelter—Sales have been made at 3.75c., and this price would still be paid, but 3.85c. and 3.90c. is asked.

Tin—The sellers are firm in their views. The asking rates are 20½c. for spot, 20.50c. for September and 20.60c for October.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Draftsman & M. E. (grad.) exp'd in hoisting, gen mach'y & R.R. work, desires pos'n. Box 88, AM. MACH.

Young man wants position as assistant draftsman. S. B. Field, Roselle, N. J.

Wanted—Pos'n by mech. draftsman; 7 years' exp. in mach. tools and gen. mach'y. Box 86, AM. MACH.

Reliable and accurate draftsman, age 25, desires position; A1 references. Box 95, A., AMER. MACH

Experienced draftsman with tech. education wants position. S. J. S., AMERICAN MACHINIST.

1st-class machine draftsman of drawing room experience is open for position. Box 82, AM. MACH.

Mechanical draftsman with exp., wants position; best refs.; country no object'n. Box 98, AM. MACH.

Draftsman & M. E. (graduated in Europe) wishes a situation; good refs. Box 78, AM. MACHINIST.

Tool maker, years of exp. on machine shop and boiler tools, wants position; N. Y. or vicinity. Address P., care AMERICAN MACHINIST.

Technical graduate, 1 year draftsman, wants position; will work part time in drawing-room and part in machine shop. Address M E, Athens, Ga.

Successful superintendent at present managing large bicycle factory desires a change; best of refs. C. F., AMERICAN MACHINIST.

Draftsman, Norwegian, age 21, tech. school grad., 2 years mach. shop exp. in this country, wants pos. as dftsman; good ref 28 Grant St., Newark, N. Y.

Draftsman (designer) experienced on mach. tools, jigs, fixtures and gen'l mach'y desires position. Box 76, AMERICAN MACHINIST.

Position as assistant mechanical engineer, assistant sup't or draftsman, by Massachusetts Institute of Technology graduate. Box 99, AM. MACHINIST.

Wanted—A first-class all around machinist. Address, giving nationality, and references as to ability, Hogan Boiler Co., Middletown, N. Y.

Wanted—By young man, first-class pattern maker and draftsman with drawing room, technical and practical experience, position with firm appreciating nice work. Box 14, AM. MACHINIST.

Mech. draftsman and designer having varied exp. on large mach'y with largest mfr's is open for engagement, West preferred; best refs.; full particulars by letter. Adaptable, AMERICAN MACHINIST.

Draftsman and designer of first-class ability desires employment; seven years' experience in engines, boilers, pumps, printing presses, sugar house work and dynamos. Address Box 97, AM. MACH.

Wanted—Machinist and pattern maker as partners in an iron foundry in St. Louis; young men each with $500 or more; a good opening. Write J. McCash, 619 Harris Avenue, St Louis, Mo.

Machine tool salesman is open for an engagement with a live, progressive firm where his sales amounting to $100,000 the past year may be doubled, and where services receive fair pay and fair treatment. Fair Play Mechanicus, AM. MACH.

Wanted—Position as sup't, or foreman, by man skilled as such, in gen. machine shop and foundry, 37 yrs. old, 12 yrs in charge of shops, sober, industrious, thorough mechanic, accustomed to contracting, gen. mach'y, steam plants, familiar with foundry. "A. B. C.," care Whitcomb, Mo.

Wanted—Situation in Phila. as sup't, assist. sup't, chief draftsman or designer by mech. engineer of 15 years' exp.; specialties, machine tools, special machines engines (steam or gas) and el. mach'y for incand't light or el. railway; best of refs. Address Box 94, AMERICAN MACHINIST.

Wanted—Mech. eng. will be open for engagement Oct. 1; exp. in steam and aut. mach.; am a thorough mech.; well up in modern shop practices and have held the positions of foreman pattern shop, sup't of construction and mech eng.; would want permanent engagement and will go anywhere; A1 references. Address Theory & Practice, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Sensitive drill $35, cost $95; screw-cutting lathe, 18" swing, $120; turret lathe, $100. 229, AM. MACH.

Massive boring & screw-cutting lathe, 54" swing, $500; 30" ditto, $385; bargains. 229, AMER. MACH.

Molder with small capital would invest in foundry. Address Founder, AMERICAN MACHINIST.

Splendid new 2 H. P. steam launch engine, $55 half price. W. Bacchus, Danbury, Conn.

Rubber, metal and composition patterns for carding & grouping; small rubber & metal work to order. John T. Usher, 116 E. 54th St., New York.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue, must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Wanted—A second hand horizontal boring machine in good order for prompt delivery, with about 3" boring bar, length of table about 5 feet, swing about 4 feet, with carriage about 30" square, with about 24" cross-feed to table; power cross-feed to table pref'd. Address, with full description, name of machine, cuts or photograph, if possible, & low't net sell'g price, to Box 96, AM. MACHINIST.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.

Taking anything from ⅛ to 1 inch inclusive.

Price.....$5.00

Patented Dec. 25, 1877.

Machinist's Size.

No.			PRICE.
1	½ to 1	in.	$10
2	1 " 1½	"	14
3	1½ " 2	"	18
4 (with screws)	2 " 3	"	32
5 " "	3 " 4	"	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.

C. W. LECOUNT, SOUTH NORWALK, CONN.

SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.

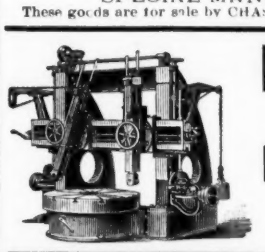
These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.



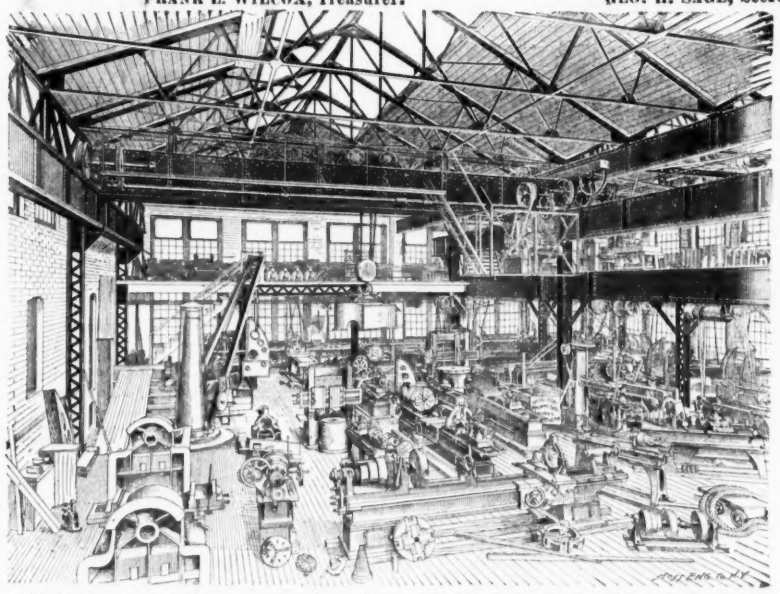
BORING AND TURNING MILLS
COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.
Chicago Office: 14 South Canal St.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.
Established a century ago.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

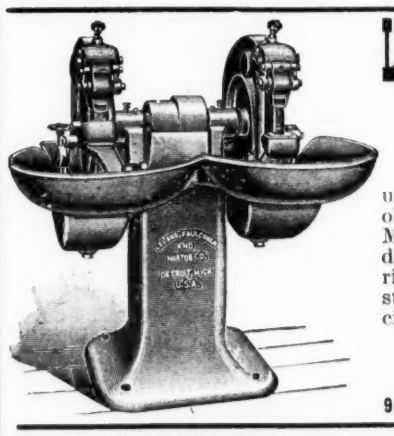
THE BERLIN IRON BRIDGE CO.,
OFFICE AND WORKS,
No. 8 Railroad Avenue, East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary

ENGINEERS, ARCHITECTS AND BUILDERS OF IRON AND STEEL BRIDGES AND BUILDINGS.



The above illustration is taken direct from a photograph and shows the interior of a Machine Shop designed and built by us for The Bridgeport Machine Tool Co., at Bridgeport, Conn. The building consists of two parts, each 40 feet in width. That shown in the immediate foreground being one story high for the erecting room, while that portion of the building shown on the right is two stories high—light work being done on the second floor.

SEND FOR OUR ILLUSTRATED CATALOGUE.



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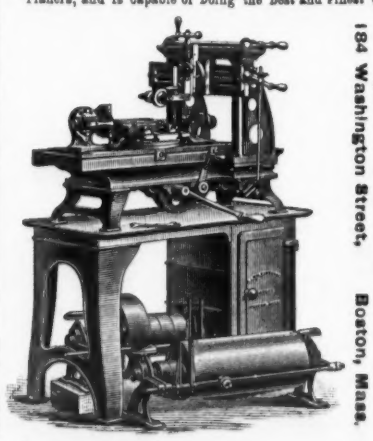

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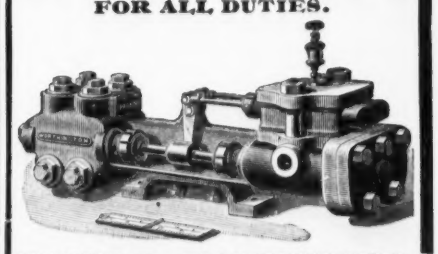

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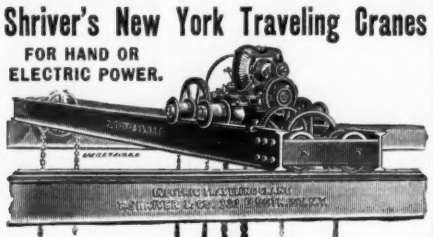

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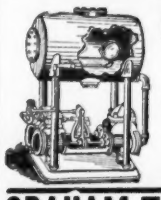

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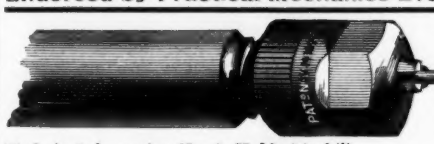

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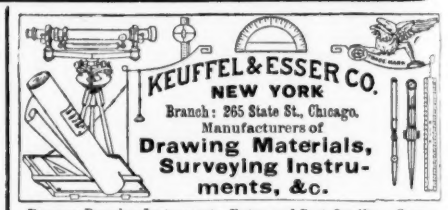

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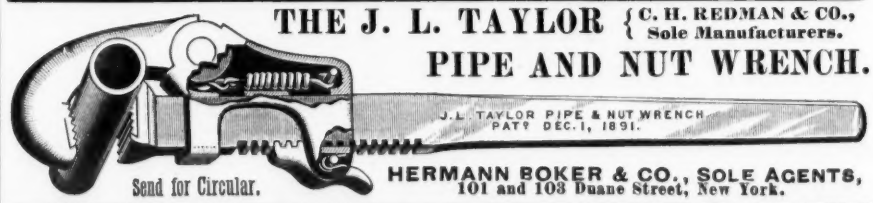

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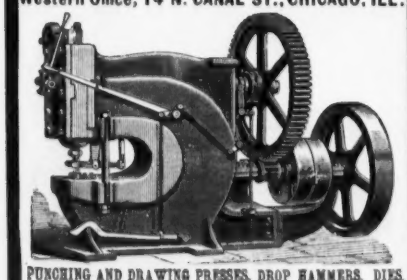

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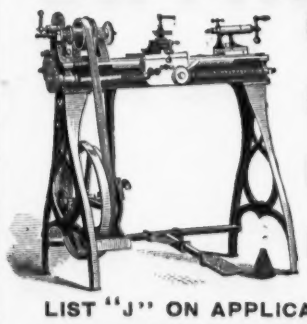

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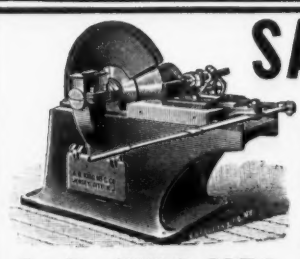

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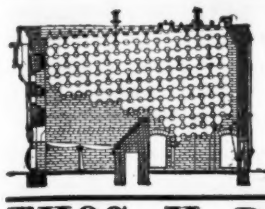

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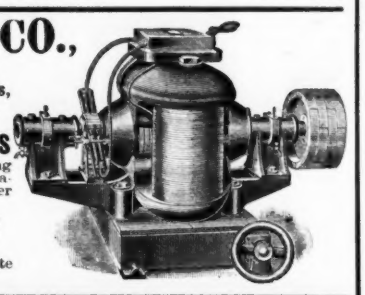

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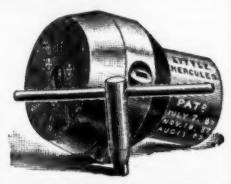

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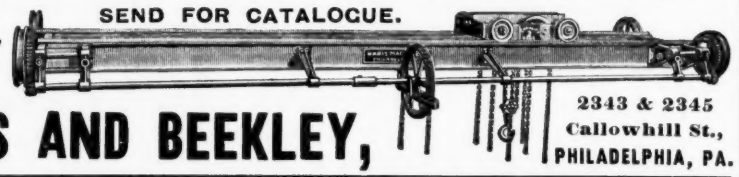

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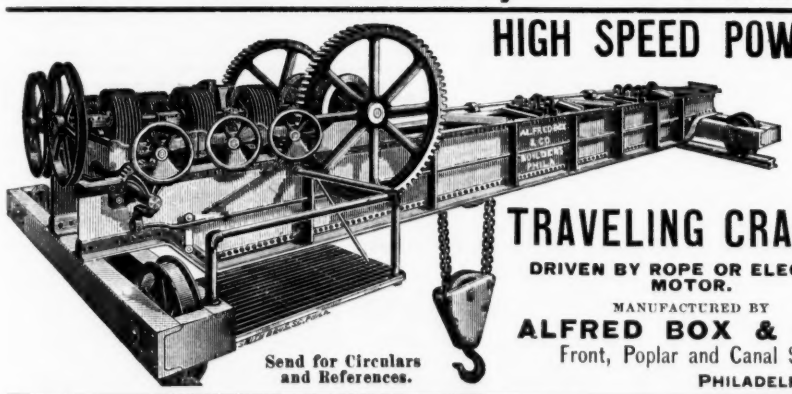

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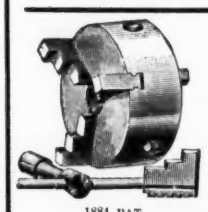

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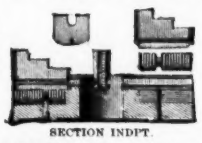

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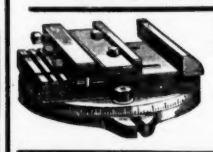

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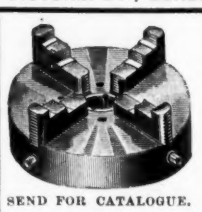

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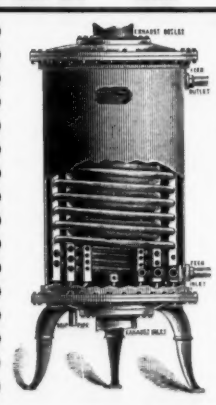

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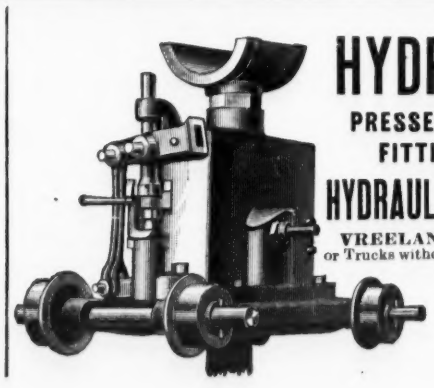

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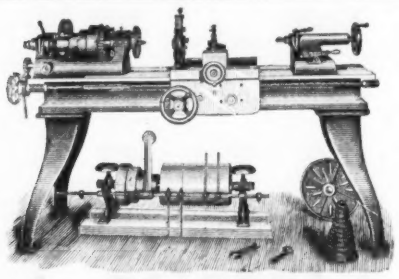

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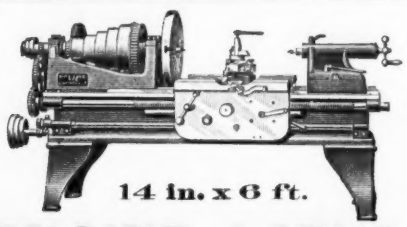

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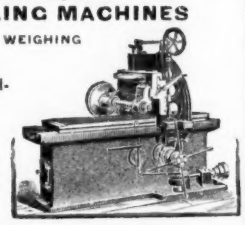

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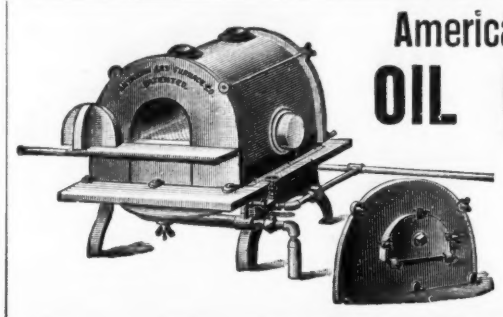

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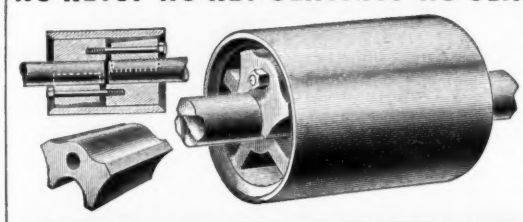

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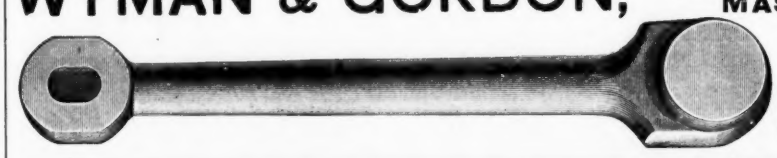

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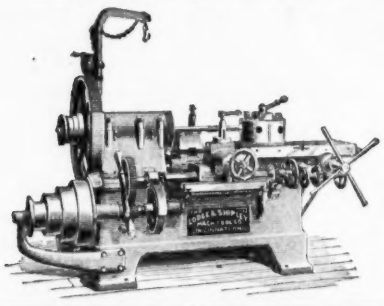

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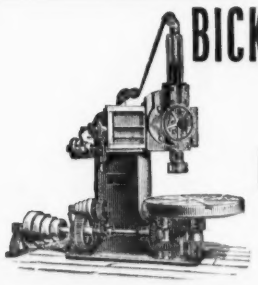

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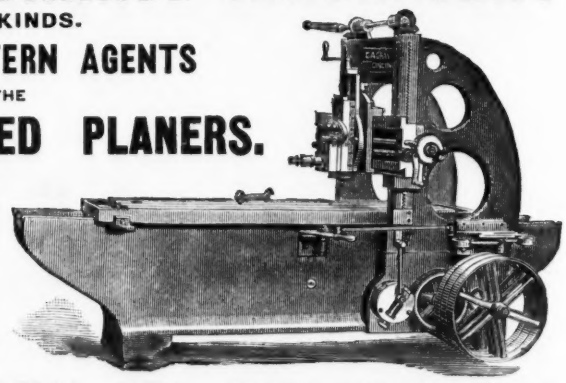

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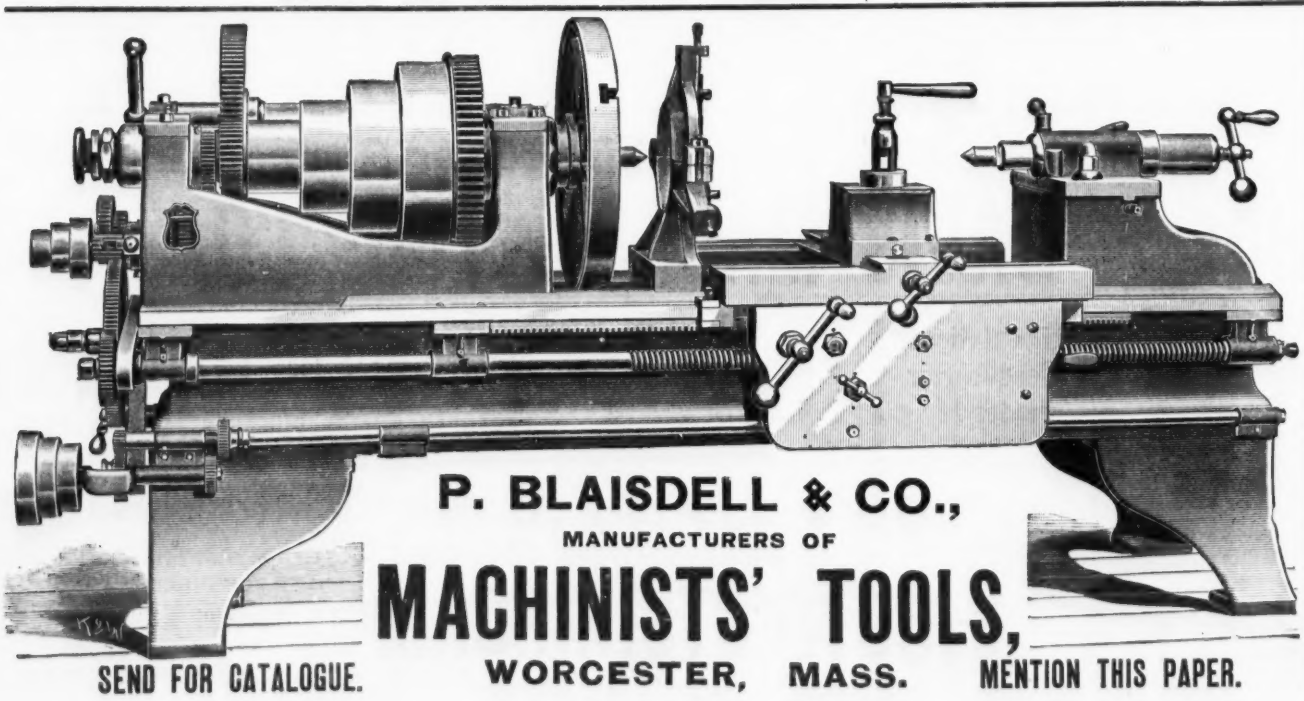

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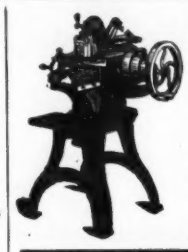

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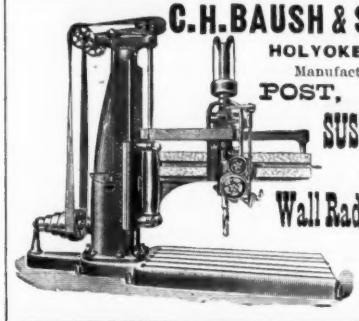

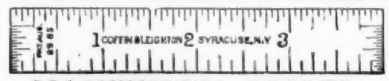

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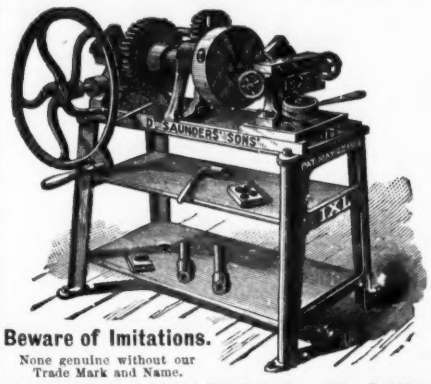

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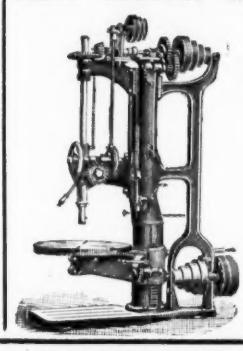

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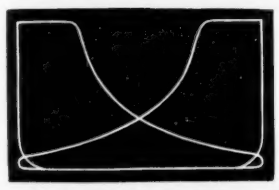

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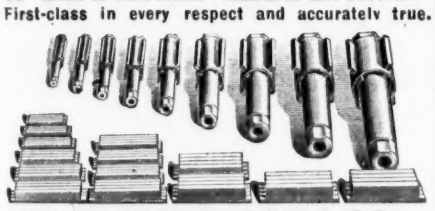

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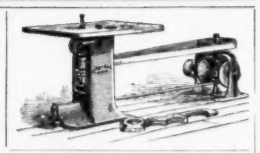

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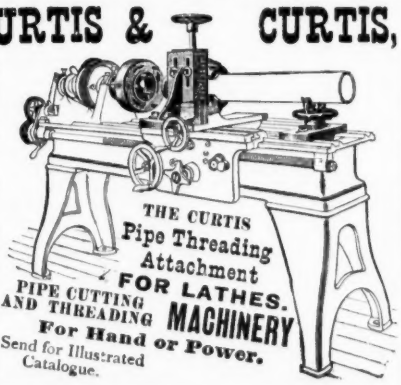

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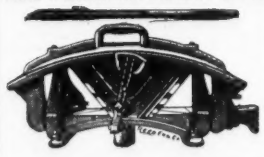

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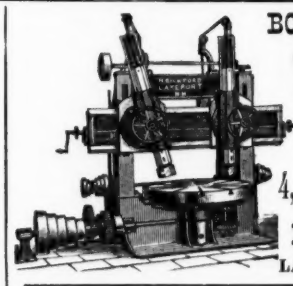

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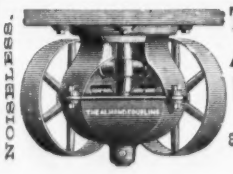

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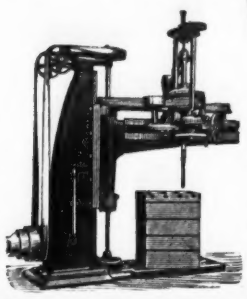

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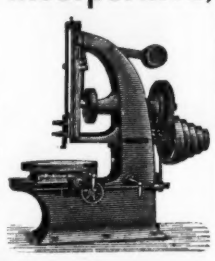

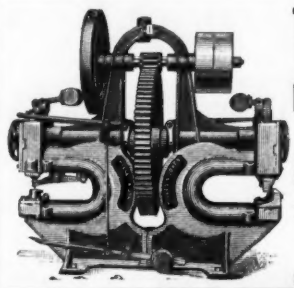

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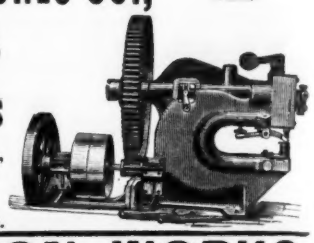

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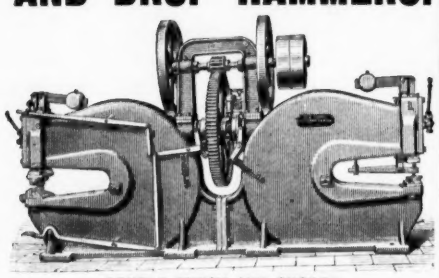

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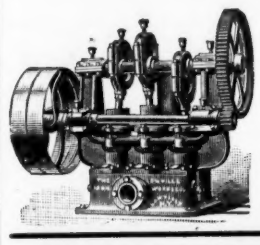

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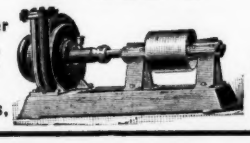

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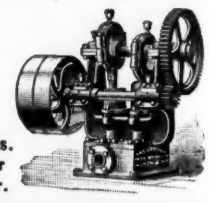

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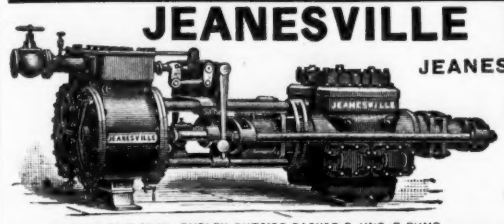

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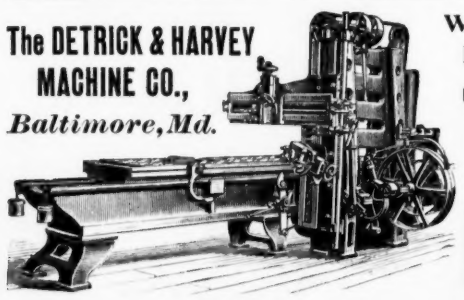

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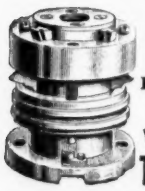

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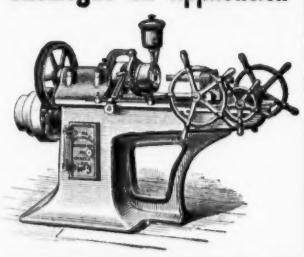

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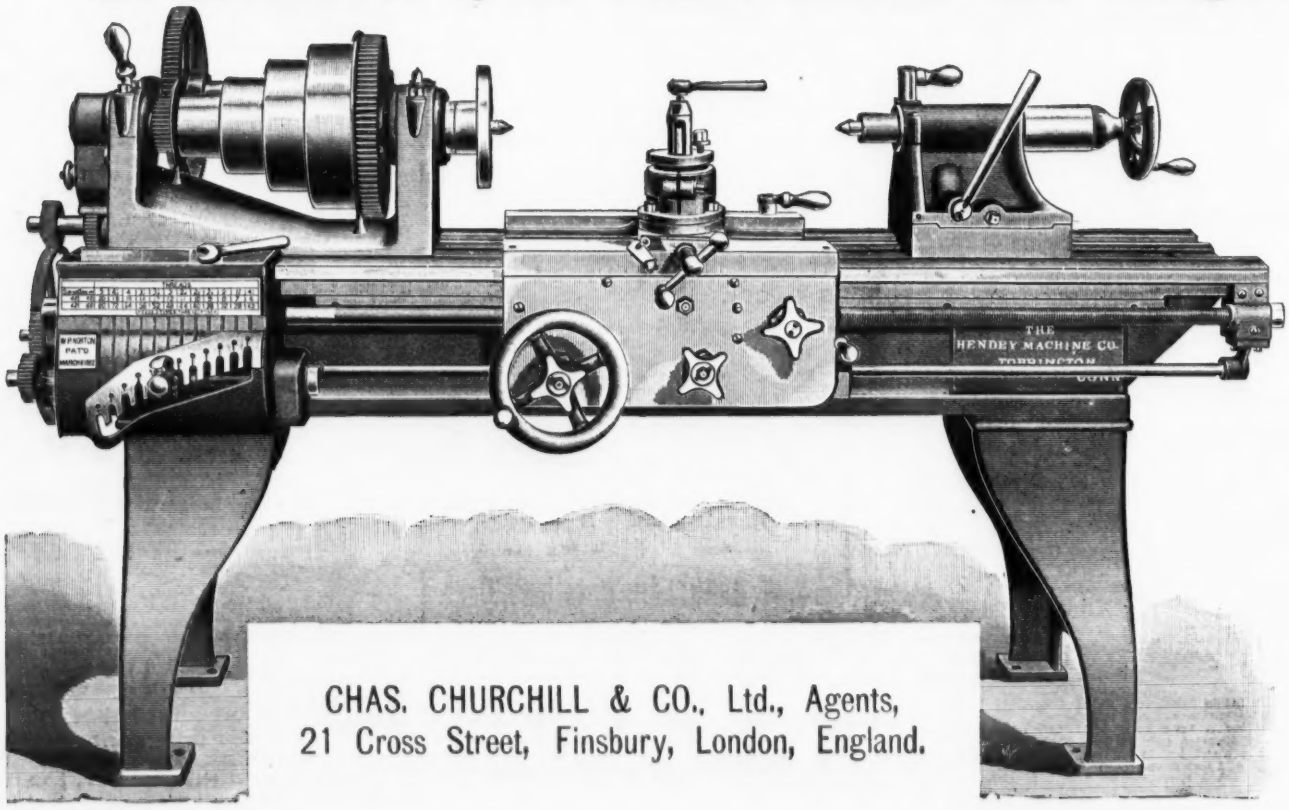

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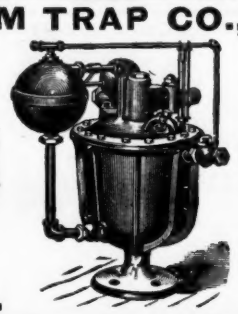

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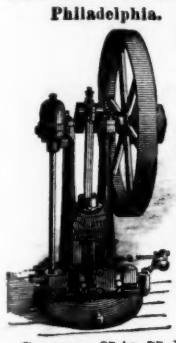

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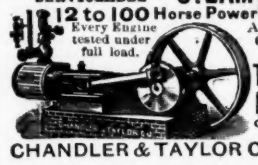

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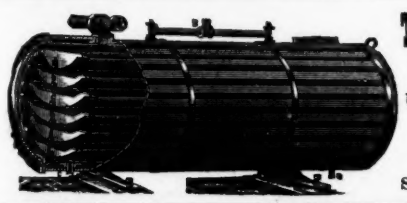

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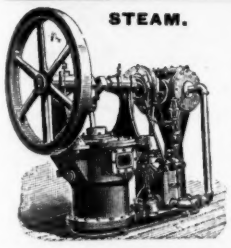

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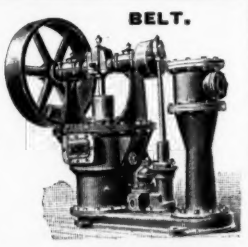

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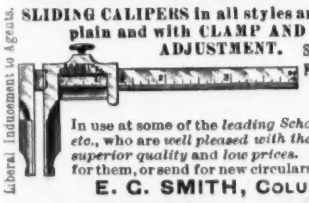

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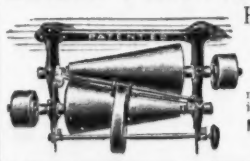

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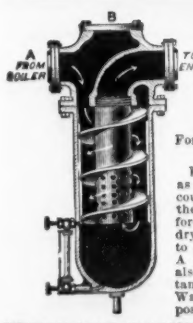

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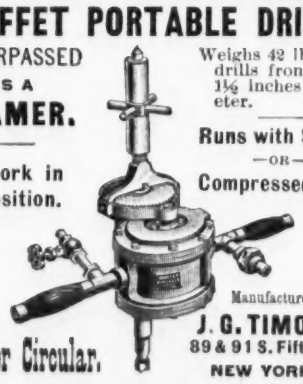

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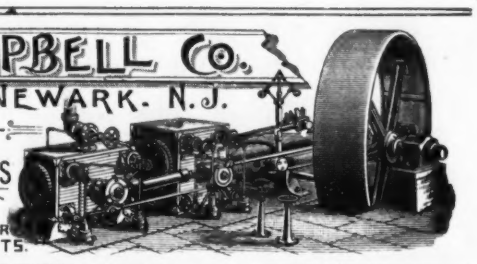

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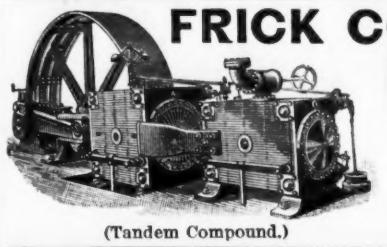

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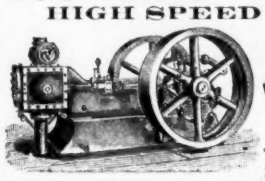

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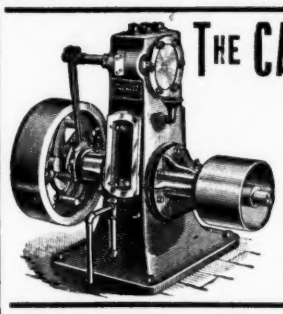

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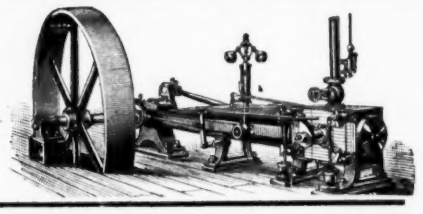

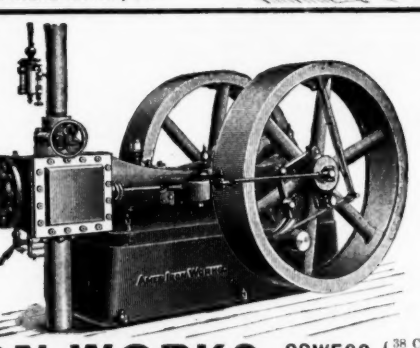

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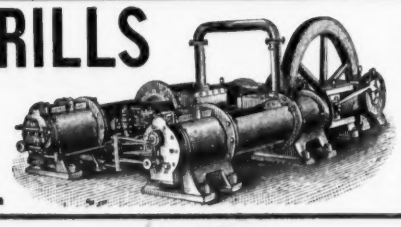

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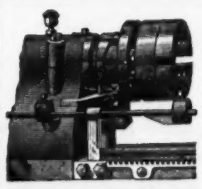

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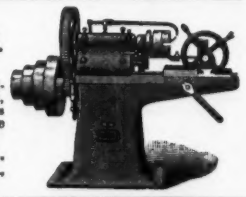

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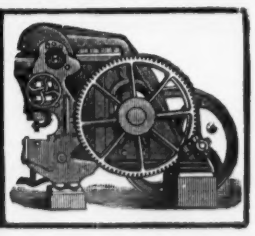

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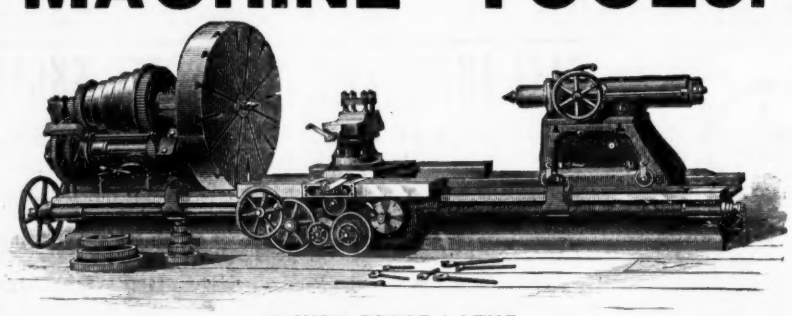
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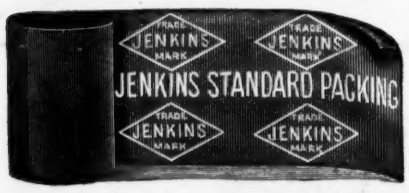

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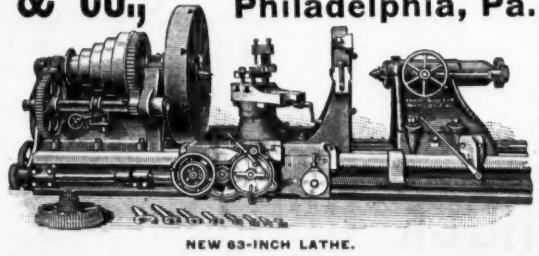
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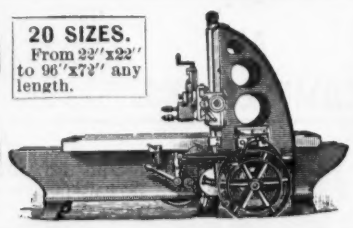

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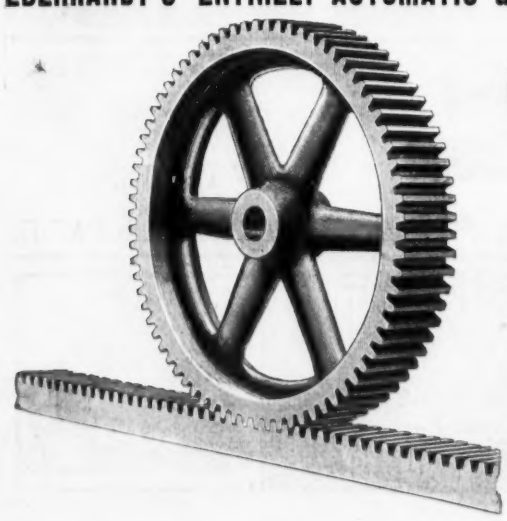
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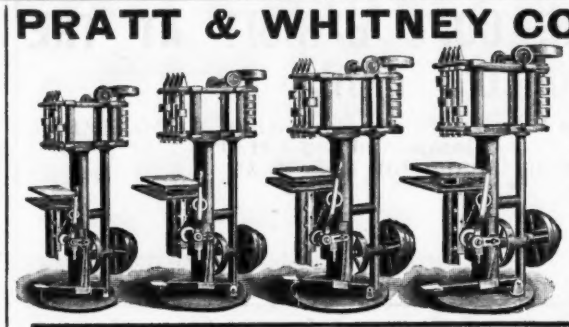
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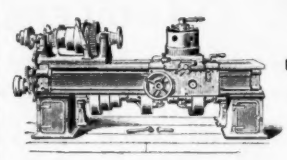
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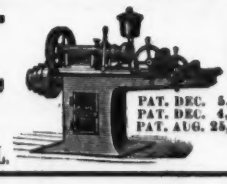
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